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BULLETIN OF THE IMPERIAL INSTITUTE

VOL. VIII, 1910

CONTENTS

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THE IMPERIAL INSTITUTE

OF THE

UNITED KINGDOM, THE COLONIES AND INDIA

THE Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire by arranging comprehensive exhibitions of natural products, especially of the Colonies and India, and providing for their investigation and for the collection and dissemination of scientific, technical and commercial information relating to them.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which H.R.H. the Prince of Wales (now H.M. the King) was President, and an Executive Council, including representatives of the Indian Empire and of all the British Colonies and Dependencies. In 1900 the building became the property of H.M. Government, by whom the western portion and galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portions being assigned, subject to rights of usage, for occupation by the University of London. In July 1902 an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee including representatives of the Colonies and India, as well as of the Colonial and India Offices, the Board of Agriculture, and the Board of Trade. This Act took effect on January 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A Committee of Management of three members, one nominated

by each of the three Government Departments chiefly concerned, has been appointed, and at present consists of Sir Alfred Bateman, K.C.M.G.; Mr. C. A. Harris, C.B., C.M.G.; and Colonel Duncan Pitcher (late Indian Army).

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their relation to agriculture and to the commercial utilisation of economic products.

The following are the principal Departments of the Institute—

Colonial and Indian Collections.—The Collections of economic products, etc., illustrative of the general and commercial resources of the Colonies and India, are arranged, together with other exhibits, on a geographical system in the public galleries of the Imperial Institute.

The following British Dominions, Colonies and Dependencies are represented by Collections—

Canada, Newfoundland; Jamaica, Turks Islands, British Honduras, British Guiana, Bahama Islands, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda Islands; Falkland Islands; New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, New Zealand; Fiji; Cape of Good Hope, Natal, Transvaal, Orange River Colony, Rhodesia, Nyasaland, St. Helena; Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria; East Africa Protectorate, Zanzibar and Pemba; Uganda; Somaliland; the Anglo-Egyptian Soudan; Malta; Cyprus; Ceylon; Hong Kong; Mauritius; Seychelles; Straits Settlements and Federated Malay States; and India.

The Colonial and Indian Collections are open free to the public daily, except on Sundays, Good Friday and Christmas Day, from 10 a.m. to 5 p.m. in summer, and from 10 a.m. to 4 p.m. in winter.

Special arrangements are made for the conduct of schools and institutions desirous of visiting the Colonial and Indian Collections for educational purposes.

A stand has been opened in the centre of the main gallery to facilitate the supply of general information and the distribution of literature. Pamphlets, circulars, handbooks, etc., containing information relating to the commerce, agriculture, mining, and other industries of the principal British Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. The principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the Departments in the main building.

In 1909 the public galleries were visited by 162,952 persons, and 10,936 Colonial and Indian publications were distributed.

A Report by the Director on the Work of the Imperial Institute in 1908 has been presented to Parliament (Cd. 4448–10).

The Scientific and Technical Department.—The research laboratories of this Department, which occupy the second floor of the Imperial Institute, were established to provide for the investigation of new or little-known natural products from the Colonies and India and of known products from new sources, with a view to their utilisation in commerce, and also to give trustworthy scientific and technical advice on matters connected with the agriculture, trade and industries of the Colonies and India.

The work of this Department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements have been also made by the Foreign Office, whereby British representatives abroad may transmit to the Department for investigation such natural products of the countries in which they are appointed to reside as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the Department, and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

Except under special circumstances investigations are not undertaken for private individuals.

A Reference Sample Room is maintained in this Department,

in which are arranged samples of the principal materials which have been investigated and valued commercially during recent years, and as to which full information is available.

The Scientific and Technical Department works in co-operation with the Agricultural and Mines Departments in the Colonies, whose operations it supplements by undertaking such investigations as are of a special scientific and technical character connected with agricultural or mineral development, as well as inquiries relating to the composition and commercial value of products (vegetable and mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of the Colonies and India, a first instalment of which was printed in a volume of *Technical Reports and Scientific Papers*, published in 1903. A series of Selected Reports is now being issued in the Miscellaneous Series of Colonial Reports. Of these Selected Reports two have been published, Part I. "Fibres" (Cd. 4588), Part II. "Gums and Resins" (Cd. 4971), whilst others are in active preparation and will be issued in the course of the present year.

Mineral Surveys, under the supervision of the Director of the Imperial Institute, and conducted by Surveyors selected by him, are in progress in Ceylon and Southern Nigeria. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained. Reports by the Director on the results of mineral exploration in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland have been printed in the Miscellaneous Series of Colonial Reports.

In connection with the operations of the Agricultural Departments in West Africa, and with a view to correlating their work and that of the Imperial Institute, an Inspector of Agriculture for British West Africa (Mr. G. C. Dudgeon) has been appointed, who visits West Africa each year, and on his return has his head-quarters at the Imperial Institute.

African Tropical Service Course.—A course of instruction in certain specified subjects is now given at the Imperial Institute to candidates selected by the Colonial Office for

administrative appointments in East and West Africa. Instruction in the subject of tropical cultivation and products in this course is given by members of the Staff of the Imperial Institute.

Library and Reading-Rooms.—The library and reading-rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference, and are regularly supplied with the more important official publications, and with many of the principal newspapers and periodicals of the United Kingdom, the Colonies and India.

The library and reading-rooms are on the principal floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute, and of other persons properly introduced. Books and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall.—The Bhownagree corridor and rooms in connection with this Hall are in the occupation of the Indian Section of the Imperial Institute, whilst the Hall is available for lectures, meetings, etc.

The "Bulletin of the Imperial Institute" is published quarterly, price one shilling (annual subscription 4*s*. 8*d*., including postage), and may be purchased at the Imperial Institute or from Messrs. Eyre and Spottiswoode, Ltd., East Harding Street, Fleet Street, London, E.C., or from agents in the Colonies and India. The *Bulletin* contains records of the principal investigations conducted for the Colonies and India at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (vegetable and mineral). The Director will be glad to consider for publication in the *Bulletin* any special articles on these subjects, which may be submitted by officials connected with agricultural, geological, mining or other technical departments in the Colonies and India. Such articles should be sent to the sub-editor, Dr. T. A. Henry, Imperial Institute, London, S.W.

The following Societies have their head-quarters at the Imperial Institute—

British Women's Emigration Association.—The British Women's Emigration Association has been assigned an office on the first floor, which is open daily from 10 a.m. to 4 p.m., and advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge. This Association works in co-operation with the Emigrants' Information Office in Westminster.

Colonial Nursing Association.—This Association has been assigned an office on the first floor of the Imperial Institute. Its principal object is the selection of trained hospital and private nurses for service in the Crown Colonies and other British Dependencies.

African Society.—This Society, which is concerned with the discussion and publication of all matters connected with British African Possessions, has been assigned an office on the Mezzanine floor, and holds meetings for the discussion of African questions. The *Journal of the African Society* is published quarterly.

The Imperial Co-operation League.—This Society has been assigned an office on the Mezzanine floor. The object of the League is to promote the closer union of the Empire, more particularly in regard to co-operation between the United Kingdom and the Self-Governing Dominions in matters of defence and Imperial policy.

BULLETIN

OF THE

IMPERIAL INSTITUTE

1910. VOL. VIII. NO. 1.

SCIENTIFIC AND TECHNICAL DEPARTMENT.

RECENT INVESTIGATIONS.

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Colonial Governments concerned.

ECONOMIC PRODUCTS FROM MAURITIUS.

AT the close of the Franco-British Exhibition, held in London in 1908, a considerable part of the exhibits shown by the Crown Colonies was transferred to the Imperial Institute to be exhibited in the Public Galleries. The materials thus transferred included a number of products from Mauritius. Later on a further supply of new products was received direct from this Colony, and these also have been placed on exhibition in the Mauritius Court of the Imperial Institute. With reference to both these groups of products the Mauritius Government requested that those which were as yet not well known in this country as products of the island might be examined in the Scientific and Technical Department and information as to their quality and value transmitted to the Colony.

The investigation asked for was therefore restricted to

materials which are at present produced on a small scale o only experimentally, and the results of this work are given in the following pages. Included with them are a number of reports on timbers and other products of Mauritius submitted to the Imperial Institute for examination in recent years.

CINNAMON BARK.

The cinnamon bark was forwarded for examination in April 1909.

The sample consisted of about 8 oz. of bark, in flat or slightly curved pieces about 6 inches long, 1¼ inches broad and ¼ inch thick. It had a characteristic cinnamon odour.

On steam distillation the finely-ground bark yielded 0·8 per cent. of oil. The quantity of oil obtained was too small to permit of detailed investigation, but it appeared to be of fair quality.

The yield of oil from the cinnamon bark of commerce varies from 0·5 to 1·0 per cent.

The sample was submitted to brokers, who reported that it was bark of a good quality known as "fair Seychelles," and worth about 1½*d.* per lb. (September 1909).

CINNAMON LEAVES.

The cinnamon leaves were received for examination in May 1909.

The sample consisted of about 6 oz. of nearly oval leaves which were pale green on the upper surface, coriaceous, and lighter coloured on the under surface.

The finely-ground leaves were steam distilled and yielded 1· per cent. of oil. The quantity of oil obtained was too small to permit of detailed examination, but judging from its odour alone it appeared to be a fair quality of cinnamon leaf oil. The usual yield of oil from cinnamon leaves is from 1·5 to 2 per cent. so that the yield from these Mauritius leaves is rather low.

It was suggested that a trial sample of about 8 oz. of the oil itself should be prepared in Mauritius and forwarded for examination and valuation, in comparison with cinnamon leaf oil of commerce.

NUTMEGS.

The nutmegs were forwarded to the Imperial Institute by the Director of Forests and Gardens in Mauritius in April 1909.

The unshelled nuts varied in size from 1 to $1\frac{1}{4}$ inch in length and from $\frac{5}{8}$ to $\frac{7}{8}$ inch in breadth, while the corresponding dimensions of the nutmegs after shelling were from $\frac{3}{4}$ to $1\frac{3}{16}$ inch and from $\frac{1}{2}$ to $\frac{3}{4}$ inch. The nutmegs were of good quality, very few being shrivelled or showing signs of decay.

The demand in this country is mainly for shelled nutmegs, and a representative selection from the present sample was therefore shelled and submitted to brokers for valuation together with some of the unshelled nutmegs as received.

The brokers valued the nutmegs in shell at $2\frac{1}{2}d.$ per lb. They pointed out, however, that there was only a very limited trade in unshelled nutmegs. The shelled nutmegs were valued at about $3\frac{3}{4}d.$ per lb. (June 1909).

MACE.

The mace was forwarded for examination in April 1909.

The sample weighed about 4 oz., and consisted of typical mace, varying in colour from pale yellow to orange red, and of good aroma and shape, but rather small.

It was submitted to brokers, who reported that it was of good colour, but small. They valued it at about 1*s.* 8*d.* per lb., but pointed out that prices had been somewhat inflated of late (June 1909).

The current values of mace in the London market on the same date were as follows:—

"Ordinary quality"	1*s.* 5*d.* to 1*s.* 8*d.* per lb.
"Medium to good"	1*s.* 9*d.* to 2*s.* 6*d.* „

The rather low value quoted for the Mauritius mace was due to its small size.

CLOVES.

A small supply of cloves was received from Mauritius for examination early in 1909. It weighed about 1 lb., and

consisted of clean cloves, free from pieces of stem, and of good quality.

On distillation the cloves yielded 18·1 per cent. of oil, which had the following constants:—

Specific gravity at 15° C.	1·0514
Optical rotation at 20° C. in 10 cm. tube	−0° 23′
Solubility in alcohol	Soluble in 2 volumes or more of 70 per cent. alcohol
Eugenol	89·1 per cent.

The results show that the yield of oil from these cloves is satisfactory, the average from commercial cloves being 18 to 19 per cent., and that the properties of the oil correspond with those of good quality oil from Zanzibar cloves.

The cloves were valued by commercial experts as "good bright Zanzibar cloves," which would sell readily at 5½*d.* per lb. (April 1909).

FRUITS OF *PIMENTA ACRIS.*

A sample of about 3 lb. of these fruits was sent for examination to the Imperial Institute in October 1906. They were identified at Kew as those of *Pimenta acris.*

On steam distillation the fruits yielded 2·7 per cent. of essential oil, which was pale yellow and of pleasant odour, resembling that of bay oil.

As the volatile oil of *Pimenta acris* fruits is not known in commerce, and had not been examined previously, a small consignment of the fruits was asked for, for further investigation.

This further supply was received in April 1909. It weighed about 14 lb., and consisted like the former sample of small, hard, roughly pear-shaped berries, varying in colour from dull orange-brown to almost black, and having the characteristic pleasant aroma of bay leaves. The material was forwarded to a large firm of essential oil distillers, who kindly undertook to make a trial distillation of the fruits. They reported that, when bruised and distilled in steam, the berries yielded 3·3 per cent. by weight of oil, which had the following constants:—

Specific gravity at 15° C.	0·9893
Optical rotation in a 100 mm. tube	− 1° 20′
Solubility	The oil was soluble in 0·8 or more volumes of 80 per cent. alcohol
Eugenol	70 per cent.

The yield of oil obtained in this small trial is higher than that obtained from the small sample examined previously at the Imperial Institute.

The volatile oil yielded by these fruits closely resembles in aroma and properties bay leaf oil, which is mainly prepared in the West Indies, and is at present worth about 8*s.* per lb.; the oil from the fruits of *Pimenta acris* would probably sell without difficulty at the same price.

The firm of oil distillers further offered to purchase a trial consignment of the fruits at the rate of 18*s.* per cwt.

In view of the relatively high price offered for the fruits, it would probably be more advantageous to ship these for distillation in Europe than to attempt the preparation of the oil in Mauritius.

GROUND NUT OIL.

A sample of this oil was forwarded in April 1909.

It was labelled "huile de pistache," and consisted of an imperial quart of pale yellow oil having a bland oleaginous odour and taste. On standing it deposited a minute amount of flocculent white matter.

On chemical examination the oil gave figures which were in close agreement with those of the ground nut oil of commerce.

It was submitted to commercial experts for valuation. They reported that they considered it to be of extra fine quality and that its value was probably about 30*s.* per cwt. (July 1909). They added that ground nut oil would be practically unsaleable in London, but that it would generally be in good demand at Marseilles.

TEA.

The samples of tea now dealt with were forwarded in April 1909.

Three kinds were submitted, viz. (1) "Golden Pekoe," (2) "Pekoe Blend," and (3) "Broken Pekoe."

Description.

(1) *Golden Pekoe.*—This consisted of brownish, small, fairly even "Fannings," with some "tip." The liquor had fair strength, with little colour, but tasted dull and peculiar. The infused leaf was dark and mixed.

(2) *Pekoe Blend.*—This was a blackish-brown, rather well twisted, wiry leaf with a few tips. It produced a light liquor with little strength and a rather peculiar flavour. The infused leaf was mixed and dull.

(3) *Broken Pekoe.*—This was a blackish-brown, fairly-twisted, even leaf with a little tip. The liquor had fair strength and some colour, but tasted dull and rather scorched. The infused leaf was too mixed and dull.

Results of Examination.

The percentage results of the chemical examination of the teas are given in the following table:—

		Moisture at 100°–105° C.	Ash.	"Extract."	"Caffeine."	"Tannin."
(1) "Golden Pekoe"	Calculated on tea as received	9·5	5·3	31·7	2·8	9·5
	Calculated on dry tea .	—	5·9	35·1	3·1	10·5
(2) "Pekoe Blend"	Calculated on tea as received	9·7	5·3	26·1	2·8	9·7
	Calculated on dry tea .	—	5·9	28·9	3·1	10·7
(3) "Broken Pekoe"	Calculated on tea as received	9·7	5·0	28·7	2·8	9·1
	Calculated on dry tea .	—	5·5	31·8	3·1	10·1

The figures in the column headed "Extract" show the percentages dissolved by treating a given quantity of tea with one hundred times its weight of boiling water and allowing it to infuse for ten minutes.

The results of analysis of some Indian and China teas are given below for comparison.

		Percentage of moisture in tea as received.	Percentages calculated on tea dried at 100° C.			
			Ash.	"Extract."	"Caffeine."	"Tannin."
Indian Teas (13 samples)	Maximum	7·8	6·9	35·2	4·1	11·1
	Minimum	6·4	5·4	27·4	3·6	6·9
	Average	7·1	6·0	31·7	3·8	9·2
China Teas (8 samples)	Maximum	9·2	8·2	27·2	3·7	9·3
	Minimum	7·1	6·0	19·0	2·6	3·3
	Average	8·2	6·8	24·3	3·0	5·2

It will be observed that the Mauritius teas resemble the Indian teas in the percentages of ash, "extract" and "tannin" they contain. The percentages of "caffeine," however, are lower than in the Indian teas, and in this respect the Mauritius teas are more like those from China.

Commercial Value.

The teas from Mauritius were submitted to a firm of tea brokers in London, who valued them as follows (August 1909):—

(1) "Golden Pekoe" . . . $6\frac{1}{2}d.$ to $7d.$ per lb.
(2) "Pekoe Blend" . . . $7d.$ to $7\frac{1}{2}d.$,,
(3) "Broken Pekoe" . . . $6d.$ to $6\frac{1}{2}d.$,,

They reported that owing to the peculiar characters of the teas, the above valuations were somewhat uncertain. The style and appearance of the teas were described as fairly satisfactory, but the leaves appeared to have been over-fermented and fired at too high a temperature.

CASSAVA MEAL.

This product, which was received in February 1909, consisted of a yellowish-white meal composed of small elongated granules. It possessed no odour, but had a slightly bitter taste.

On analysis it gave the following results:—

	Per cent
Moisture	14·25
Ash	1·04
Starch	71·75
Soluble carbohydrates	4·87
Crude proteins	1·65
Fat	0·12
Fibre	6·32

These figures show that the meal is of fair, average composition, with a rather high percentage of sugars.

The material was submitted to brokers, who valued it at £4 per ton in London (April 1909).

MAIZE FLOUR.

This sample consisted of a dull, yellowish, granular powder, with a slightly sour and bitter taste, but devoid of any marked odour.

An analysis gave the following results:—

	Per cent.
Moisture	12·59
Ash	2·09
Starch	71·06
Crude proteins	10·28
Fat	2·85
Fibre	1·13

These figures indicate that the flour is rather low in fat, but is otherwise of average composition for maize flour.

The results of recent inquiries as to the possibility of introducing maize flour and similar products from new sources into the market in this country, show that there is at present but little demand for such products, and that a new market for them would have to be created.

SWEET POTATO STARCH.

This was a clean, well-prepared starch, free from gritty matter and containing no apparent impurity. It was analysed with the following results:—

	Per cent.
Moisture	13·74
Ash	0·03
Starch	85·24
Crude proteins	0·84
Fat	0·15

These figures indicate that the starch is of satisfactory composition.

This sample was valued at £8 per ton by brokers, but this value cannot be regarded as certain, since the starch is practically

unknown in this country, and trials with it would need to be made before a price could be definitely assigned to it.

FIBRES.

Kapok.

This kapok was forwarded to the Imperial Institute in May 1906. It weighed $2\frac{1}{4}$ lb. and was labelled "Kapok (*Eriodendron anfractuosum*), Royal Botanic Gardens, Pamplemousses, Mauritius."

The kapok was fairly clean, but some portions were stained and dirty; it was light golden-brown in colour, soft and silky, and of very good lustre. The sample showed the resiliency and somewhat poor strength which are characteristic of kapok.

The fibres varied in length from 0·7 to 1·0 inch, and in diameter from 0·0005 to 0·0015 inch, with an average of 0·00096 inch.

Compared with a standard commercial sample of kapok, this specimen from Mauritius was slightly darker and more uneven in colour, and of inferior lustre, but no other difference was observable.

Kapok is utilised as an upholstery material, and for this purpose it is worth about *6d.* per pound in this country if clean, free from seeds, and of good quality. The present sample from Mauritius would probably be worth from $4\frac{1}{2}$*d.* to *5d.* per lb. in the London market (February 1907).

Sisal Hemp.

The sample weighed 1 lb. 9 oz. and was received in May last. It was very well prepared, white fibre, of fair lustre and rather finer than is usual for Sisal hemp. The average length was 4 feet 6 inches, but some short lengths of 3 feet 9 inches were present.

On analysis the fibre gave the following results:—

	Per cent.
Moisture	8·6
Ash	0·5
a-Hydrolysis, loss	7·8
β-Hydrolysis, loss	10·1
Acid purification, loss	0·5
Cellulose	83·0

For comparison with the above results the figures obtained at the Imperial Institute for samples of the same fibre from the East Africa, Nyasaland and Uganda Protectorates, may be quoted:—

	Sisal hemp from British East Africa.	Sisal hemp from Nyasaland.	Sisal hemp from Uganda.
	Per cent.	*Per cent.*	*Per cent.*
Moisture	11·1	9·2	7·9
Ash	1·0	0·5	0·7
α-Hydrolysis, loss .	11·2	8·6	9·2
β-Hydrolysis, loss .	14·1	11·1	11·3
Cellulose	78·2	80·9	80·3
Acid purification, loss	2·3	0·3	0·7

These results show that the fibre from Mauritius is of superior quality to the other specimens, as it contains a higher percentage of cellulose and suffers a smaller loss on hydrolysis; it should therefore prove a very durable fibre.

The fibre was valued at about £30 per ton (September 1909).

LOGWOOD.

The logwood which is the subject of this report was received in May 1909.

The sample selected at the Imperial Institute for detailed investigation consisted of a small billet of wood about 2 feet long and 3½ inches in diameter. It was pale to deep orange yellow in colour and showed none of the characteristic purple tinge of fully fermented logwood.

The logwood was submitted to experts, who conducted experiments with the material. Only the most deeply coloured portion of the sample was used, but it was nevertheless found to be considerably inferior to Central American logwood, the respective tinctorial strengths of the two being approximately as 75 to 100.

It would not, however, be reasonable to judge of the general quality of Mauritius logwood from an isolated sample, and it is possible that richer material may be available.

The manufacturers who tested the present sample have offered to purchase a ton of Mauritius logwood at its market value, based on the quantity of colouring matter which the consign-

ment is found to contain, and to report on its suitability for extract manufacture. They state, however, that if the average wood obtainable in Mauritius does not yield a larger amount of colouring matter than the present sample, it is unlikely to find a market in this country.

TIMBERS.

The timbers which are the subject of this report were forwarded to the Imperial Institute by the Acting Colonial Secretary in Mauritius in August 1906.

The specimens were as follows:—

Serial No. of specimen.	*Local name of timber.*	*Botanical name.*
2766	Sandal	*Noronhia Broomeana.*
2951	Colophane	*Canarium Colophania* (*C. mauritianum*).
4120	Tambalacoque	*Sideroxylon grandiflorum.*
4492, 4827	Natte	*Imbricaria maxima.*
4591	Pomme	*Eugenia* sp.
4611	Clou	*Eugenia cotinifolia.*
4629	Loustau	*Antirrhoea verticillata* (*Quivisia Sieberi*).
4829	Ebène marbre	*Diospyros melanida.*
4851, 4852	Bigaignon	*Psiloxylon mauritianum.*
4752, 218	Makak	*Imbricaria petiolaris.*

Mechanical Properties.—The mechanical properties of the timbers have been investigated for the Imperial Institute by Prof. Dalby, F.R.S., of the Engineering Department of the City and Guilds Central Technical College, and the results obtained are given below.

The tests were carried out in the manner described in the introduction to the section on Colonial timbers in the volume of "Technical Reports and Scientific Papers," Part I, p. 243, issued by the Imperial Institute in 1903. The transverse tests were made on rectangular bars 36 inches in length, 3·5 to 4 inches in breadth, and 3·4 to 3·9 inches in depth. The crushing stress

Results of Mechanical Tests of Mauritius Timbers.

Number of Log.	Name.	Density (lb. per cubic foot).	Transverse Tests. Coefficient of Rupture (lb. per sq. inch).	Transverse Tests. Elastic Load up to	Transverse Tests. Stress at elastic limit (lb. per sq. inch).	Transverse Tests. Modulus of Elasticity (lb. per sq. inch).	Shearing stress (lb. per sq. inch).	Crushing stress (tons per sq. inch).
2766	Sandal	55·6	14,470	7,500 lb.	9,160	1,850,000	460	3·97
2951	Colophane	50·7	15,500	7,000 lb.	8,050	1,810,000	1407	3·61
4120	Tambalacoque	55·1	21,100	9,000 lb.	10,000	2,500,000	1450	4·16
4492	Natte	52·9	16,400	8,000 lb.	7,060	1,935,000	953	4·15
4827	Natte	—	—	—	—	—	1545*	3·82
4571	Pomme	34·1	9,440	5,000 lb.	5,620	1,075,000	988	2·52
4611	Clou	61·0	23,850	5,500 lb.	7,660	2,202,000	1965	4·47
4629	Loustau	38·3	12,580	7,500 lb.	7,860	1,649,000	1490	2·94
4829	Ebène marbre	47·9	7,900	5,450 lb.	5,380	1,432,000	1520	2·81
4851	Bigaignon	—	—	—	—	—	886	3·078
4852†	Bigaignon	—	—	—	—	—	830	2·853
4752	Makak	—	—	—	—	—	1030	3·675
218	Makak	—	—	—	—	—	1410	3·545

* *This was a fracture along the grain of the wood.*
† *This timber is thought to be identical with No. 2951, and to be "Colophane," not "Bigaignon. There was a flaw in this block, along which it splintered during the test.*

was determined on prisms of the timber about 5 inches in height and from about 3 × 3 inches to 3½ × 3½ inches in section. Shearing tests were also made. The results of these various tests are given in the table on p. 12.

In the case of the two timbers Makak and Bigaignon, satisfactory test pieces for the transverse tests could not be obtained from the specimens available.

The results of the mechanical tests indicate the relative strengths of these Mauritius timbers, and will enable comparisons to be made with well-known European and tropical woods. For this purpose the following table, representing fair average results for European timbers, may be quoted from "Technical Reports and Scientific Papers" (*loc. cit.*).

Name.	Density.	Coefficient of Rupture.	Crushing Stress.
	(*lb. per cubic foot.*)	(*lb. per sq. inch.*)	(*tons per sq. inch.*)
Oak	52	12,000	4·464
Elm	34	8,000	4·598
Ash	47	13,000	4·018
Red Pine	37	8,300	2·589

The Mauritius timbers are on the whole heavier and harder than these European woods, and it will be seen that most of those which were submitted to transverse tests possess greater strength, as indicated by the coefficient of rupture, than the latter. The results of the mechanical tests of a large number of tropical hard woods are also given in the above-mentioned volume of "Technical Reports," and will serve for comparison with the figures here recorded for these Mauritius timbers.

Working Qualities.—For the determination of their working qualities the timbers were submitted to the Expert Referee on Timbers to the Imperial Institute, who reports that they all appear to be useful timbers, which should be of considerable value in the Colony. In view, however, of the timbers with which they would have to compete if brought to Europe, he is of opinion that none of them can be considered as marketable here, but that if sufficient supplies are

available, all of them might find a market at the Cape of Good Hope.

The following detailed report on the specimens has been furnished:—

"SANDAL" (No. 2766).

A cross-grained wood of yellowish-brown colour, poor, stripy, of medium hardness, and not ornamental. The aroma is characteristic and somewhat resembles that of sandal wood, but is rather faint. The surface is dull, and the grain fine. The wood saws readily, turns and polishes well, but planes hard and indifferently.

"COLOPHANE" (Nos. 2951 and 4852).*

A prettily-marked wood of reddish-brown colour, with a bright surface and rather coarse, straight, open grain; it turns dark brown on weathering. The wood is of medium hardness, saws readily, and turns, planes and polishes well. It is a furniture wood of distinctly good appearance, and has been used for canoes.

"TAMBALACOQUE" (No. 4120).

A very hard, heavy wood of yellowish colour, with dark yellowish-brown stripes. It is resinous, and bleeds from the dark wood, staining the surface. The wood is solid, compact, fine and close-grained, very hard to work, but turns, polishes and planes very well; the surface has an oily lustre when planed. It is scarcely ornamental, but is a good turner's wood.

"NATTE" (No. 4492).

A light red or reddish-brown wood of uniform colour and medium hardness; compact, solid, sound and of fine and straight grain. It saws easily, and turns, planes and polishes well; the surface is bright when planed. It has a very good appearance and would doubtless prove to be a good furniture wood.

* *Sent as "Bigaignon" (see No. 4851).*

"NATTE" (No. 4827).*

It is suggested that this wood is the Bois Amer St. Martin. A light red wood of uniform colour, weathering very dark brown, and resembling good American birch. The surface glistens from the number of minute globules of resin in the pores, and the appearance is good, though not striking. The wood has a bitter taste. It saws easily, producing a reddish dust, turns and planes moderately well, and takes a good finish. It is a generally useful wood, especially for furniture for export.

"POMME" (No. 4571).

A soft wood of uniform, light-brown colour and rather pretty figure, resembling light-coloured elm, with dull surface and fine grain. It saws easily, turns and planes well, but polishes indifferently. It is not a furniture wood. The specimen was tainted with decay.

"CLOU" (No. 4611).

A hard wood of sober, brown colour, with dark stripes (which may possibly be a defect in the specimen), and not ornamental. The surface is dull, and the grain fine and close. The wood is very hard to saw and work, but turns and polishes well.

"LOUSTAU" (? Losteau) (No. 4629).

A soft wood of uniform, dull yellow colour, the surface being dull when planed and the grain fine and straight. The wood saws, turns and planes easily, and polishes fairly well. It is a likely wood for general purposes, but is not ornamental.

"EBÈNE MARBRE" (No. 4829).

No ebony was present beyond traces round the worm-holes, of which the specimen was full. The sapwood is dark, and darkens further on weathering. The wood saws fairly easily, and turns and planes moderately well, but polishes indifferently. The absence of heartwood, however, renders the tests of little value.

* *This specimen of timber may not be identical with No. 4492, which bears the same name.*

"BIGAIGNON" (No. 4851).

A wood of uniform brown colour and good appearance, having a slightly cheese-like smell; hard and heavy, with a fine, straight grain. It saws readily, turns and planes moderately well, and takes a good finish when polished; the surface is bright when planed.

"MAKAK" (Nos. 218 and 4752).

A rich brown wood with dusky stripes, scarcely ornamental, and of medium hardness and weight. It saws rather hard, producing a red dust, turns well, planes hard, and polishes very well; the surface has an oily lustre when planed. The specimens were badly "shaken" right through.

RUBBERS FROM SIERRA LEONE.

THE rubber-yielding plants indigenous in Sierra Leone include *Funtumia elastica*, Stapf, the West African rubber tree, and species of Landolphia vines. A number of samples of rubber from both these sources have been forwarded to the Imperial Institute from the Colony, and the results of their examination are given in the following account.

RUBBER OF *FUNTUMIA ELASTICA*.

(1) "*Funtumia elastica* rubber. No water added to latex." Weight, 8 oz.

The sample consisted of three thin sheets of rubber and one small thicker piece, all of which were dark brown and had a rather rough appearance. The rubber was clean, and had apparently been smoked; its physical properties were very satisfactory.

An analysis furnished the following results:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	3·5	—
Caoutchouc	83·5	86·6
Resin	5·7	5·9
Proteids	5·8	6·0
Insoluble matter	1·5	1·5
Ash	1·17	1·20

The specimen was valued at about 3*s*. per lb. in this country, with fine hard Para quoted at 3*s*. 5½*d*. per lb.

The rubber is of good quality, but its rough appearance and dark colour detract slightly from the market value.

(2) "Funtumia rubber. Prepared by diluting 1 part of the latex with 10 parts of water and boiling." Weight, 2¼ lb.

The specimen consisted of thin irregular biscuits, which were very moist and mouldy on the surface when received. Before analysis and valuation, the mould was removed and the surface moisture driven off by exposure to a gentle heat. The biscuits were dark coloured, clean, rather rough on the surface, and had a smoky odour. The physical properties of the rubber were very satisfactory.

An analysis gave the following results:—

	Rubber after partial drying. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	9·4	—
Caoutchouc	81·9	90·5
Resin	5·7	6·3
Proteids	1·8	1·9
Insoluble matter	1·2	1·3
Ash	0·27	0·29

The rubber was described by brokers as "fairly clean rough biscuits; strong, well-prepared and in good condition," and was valued at 4*s*. to 4*s*. 3*d*. per lb. in London, with fine hard Para quoted at 4*s*. 7*d*. per lb.

This rubber is of good quality, containing over 90 per cent. of caoutchouc in the dry material, whilst the amounts of resin, proteid and insoluble matter are all low. The sample as received contained an excessive quantity of moisture, and in consequence there had been a considerable development of mould on the surface of the biscuits during transit. It was stated, however, that the sample had not been dried thoroughly before despatch, as would be done in the case of rubber prepared for sale. The price quoted for the biscuits after partial drying here was very satisfactory.

(3) "Funtumia rubber. Prepared by diluting the latex with an equal quantity of water and boiling." Weight, 2½ oz.

Two small oval pieces of almost black, clean rubber, slightly mouldy on the surface. The rubber exhibited very good elasticity and tenacity.

The rubber had the following composition:—

	Rubber as received. Per cent.	Composition of dry rubber. Per cent.
Moisture	7·9	—
Caoutchouc	84·0	91·2
Resin	5·3	5·7
Proteids	2·4	2·6
Insoluble matter	0·4	0·4
Ash	0·30	0·42

The sample was valued at 4*s.* per lb. in London, with fine hard Para at 4*s.* 7*d.* per lb.

This rubber agrees well in composition with the preceding specimen, and is of good quality. It was forwarded in order to show the amount of moisture which would be present in thoroughly prepared samples.

LANDOLPHIA RUBBER.

(1) A number of small samples of specially prepared Landolphia rubber were received for comparative examination.

Eight of the specimens, Nos. 1 to 8, were in the form of small biscuits, varying from 2 to 7 inches in diameter, and some of them not more than $\frac{1}{32}$ inch in thickness. The rubber was clean, well prepared, of brown colour, translucent, and had a distinct smoky odour; it exhibited very good elasticity and tenacity.

Sample No. 9 was in the form of thin strips of reddish-brown rubber, which exhibited good physical properties.

Sample No. 10 consisted of small balls of rubber about 1 inch in diameter prepared by the native method. The balls were dark coloured, rather sticky on the surface, and contained a fair amount of vegetable impurity. The rubber was strong and elastic.

For the purpose of analysis No. 7 was chosen as representative of the "biscuit" rubber, and the figures obtained for it, together with those for Nos. 9 and 10, are given in the following table:—

	No. 7. Per cent.	No. 9. Per cent.	No. 10. Per cent.
Moisture	1·8	1·8	5·2
Caoutchouc	85·2	85·2	75·9
Resin	11·8	11·6	9·5
Proteids	0·8	1·0	1·6
Insoluble matter	nil	nil	6·2
Ash	0·4	0·4	1·6

These results indicate that samples Nos. 7 and 9 are of good quality and almost identical in composition. They contain over 85 per cent. of caoutchouc and only a small percentage of proteids; the amount of resin, however, is a little high. The balls prepared in native fashion (No. 10) contain a fair amount of insoluble impurity, and whilst the percentage of proteids is higher than in the other samples the quantity of resin is lower.

The samples were submitted to brokers for valuation, with the following results:—

The eight samples of biscuit rubber (Nos. 1 to 8) and the strips (No. 9) were stated to be very satisfactory both in preparation and appearance, and were valued at the same price, viz. 5*s.* per lb., with fine hard Para from South America quoted at 5*s.* 10*d.* per lb. The balls (sample No. 10) were valued at 3*s.* 6*d.* per lb. on the same date.

It is evident from these results that the Landolphia rubber in "biscuits" or "strips" will realise a much higher price than the same rubber prepared in balls by the native method.

(2) "Landolphia rubber prepared in strips by the natives."

The sample weighed 15 oz., and consisted of 15 flat strips of rubber about 1 foot in length and from 1 to 1½ inch in width. The rubber was clean, dark coloured, and had a smoky odour; its physical properties were very satisfactory.

The rubber had the following composition:—

	Per cent.
Moisture	2·8
Caoutchouc	83·5
Resin	9·5
Proteids	1·7
Insoluble matter	2·5
Ash	0·73

The sample was valued at 3*s.* 6*d.* to 3*s.* 9*d.* per lb., with fine hard Pára at 4*s.* 7*d.* per lb.

The rubber compares favourably in composition with the specially prepared specimen (No. 9) described above, but its darker colour and rougher appearance reduce its value.

(3) "Landolphia rubber from the Karene District."

This sample weighed 2⅓ lb., and consisted of small balls of dark brown rubber, which were slightly sticky both externally and internally and contained a fair amount of vegetable impurity.

The composition of the rubber was as follows:—

	Per cent.
Moisture	2·2
Caoutchouc	80·6
Resin	6·5
Proteids	1·4
Insoluble matter	9·3
Ash	0·98

The sample was valued at 3*s.* 4*d.* to 3*s.* 6*d.* per lb., with fine hard Para quoted at 4*s.* 7*d.* per lb.

This rubber is of good quality, but contains a large amount of vegetable impurity, which could be considerably reduced by the exercise of more care on the part of the natives during collection.

(4) "Landolphia rubber from *Landolphia owariensis*, var. nr. *Junje*."

The sample consisted of three sheets of rubber and one small ball, which together weighed 6 oz. The rubber had apparently been smoked, and varied in colour from brown to black; it exhibited good elasticity and tenacity.

An analysis gave the following results:—

	Per cent.
Moisture	5·4
Caoutchouc	84·8
Resin	8·5
Proteids	1·0
Insoluble matter	0·3
Ash	0·42

The sample was valued at 3*s.* per lb. in this country, with fine hard Para quoted at 3*s.* 5½*d.* per lb.

This rubber is of good quality, and consignments of similar character would be readily saleable.

(5) "Rubber of *Landolphia* sp."

The sample weighed 3 oz., and consisted of one small piece and one small ball of black rubber. The rubber was clean and exhibited good elasticity and tenacity.

The rubber had the following composition:—

	Per cent.
Moisture	8·2
Caoutchouc	76·2
Resin	7·4
Proteids	5·3
Insoluble matter	2·9
Ash	1·85

The sample was valued at about 3*s.* per lb. in this country, with fine hard Para quoted at 3*s.* 5½*d.* per lb.

The rubber is of good quality, but not quite equal in composition to the preceding specimen, No. 4.

TARTAR GUM FROM THE SUDAN.

THE "tartar" gum which is the subject of this report was forwarded to the Imperial Institute in April 1909.

The sample weighed 4¾ lb., and consisted of thick horny flakes and irregularly-shaped fragments of gum, white or yellowish-white in colour. Some of the pieces were translucent, and many were marked on the surface by parallel ridges, like tragacanth. The gum had no marked taste or odour.

The gum was examined and the results, compared with those obtained for it and other similar gums at the Wellcome Research Laboratories, Khartoum (see *Third Report of the Laboratories*, p. 438), are given in the following table:—

	Present sample from Soudan.	Results obtained in the Wellcome Research Laboratories, Khartoum.		
		Sterculia tomentosa gum Bahr-el-Ghazal.	*Sterculia cinerea* gum Sennar.	*Sterculia tomentosa* gum Senegal.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	10·36	15·26	13·12	8·99
Ash	6·68	7·05	5·48	6·70
Acid number*	12·88	13·79	14·59	13·00

* *Milligrams of potassium hydroxide required to neutralise one gram of gum.*

When placed in water the "tartar" gum swells to a jelly. It belongs, therefore, to the class of so-called "insoluble" gums, of which tragacanth gum is the best-known type.

The most remarkable feature of the analytical results quoted above is the high acid number of this gum, in which respect it agrees with the similar gums examined at the Wellcome Research Laboratories, Khartoum.

It has long been known that the gum derived from *Sterculia urens* slowly evolves acetic acid on exposure to air, and it was of interest, therefore, to ascertain whether the high acid number of this "tartar gum" was due to a similar cause.

It was found that when the gum, as received, was kept in a stoppered bottle, the air in the bottle slowly acquired an acid reaction to test paper.

A full investigation was made in 1906 at the Imperial Institute of the gum of *Cochlospermum Gossypium* from India, which also possesses this property of liberating acetic acid on exposure to air, and it was found in that case that the gum was a complex acetyl derivative from which the whole of the acetic acid could readily be obtained by hydrolysing the gum with acids (see Robinson, *Transactions of the Chemical Society*, 1906, 89, 1496). On applying this method of hydrolysis to the "tartar gum," 17·16 per cent. of acetic acid was obtained. The acid was identified by the usual reactions and by analysis of its silver salt.

The liberation of acetic acid by this gum is of some importance from a commercial point of view, since it may limit somewhat the use of the gum as a substitute for tragacanth; thus the acidity of the jelly formed by the gum with water

rapidly increases on keeping, whereas similar jelly made with tragacanth gum remains almost neutral.

Commercial Valuation.

The gum was submitted to commercial experts, who reported that it was similar to a gum imported from Calcutta and that it would be saleable in London if properly prepared for the market. Such preparation would involve the picking out of the darker pieces and those with bark adhering to them, after which the white gum would be worth about 45*s.* to 50*s.* per cwt. (June 1909), and the pickings 20*s.* to 25*s.* per cwt. The experts also stated that the bulk of the present sample consisted of roundish pieces, but that thin flaky gum would be considerably more valuable.

GENERAL NOTICES RESPECTING ECONOMIC PRODUCTS AND THEIR DEVELOPMENT.

PREPARATION OF BEESWAX.

MODERN methods of bee-culture, as adopted in most European countries, Australia, the United States of America and elsewhere, have for their primary object the production of honey, since the latter realises a better price than wax. In former times when bees were kept in "skeps" or boxes a large number of swarms were destroyed annually, and the whole of the comb, after the honey had been extracted, was converted into wax. As one result of the use of moveable box hives it is no longer necessary to destroy all the comb, but merely to remove the cell-capping and extract the honey by means of a machine. The empty comb can then be returned to the hive and re-filled. As bees consume a large quantity of honey in order to make wax, the modern bee-keeper effects a considerable saving in this respect by using the same comb several times. This practice, however, withholds a considerable quantity of wax from the market. The modern custom of retailing honey in the comb, owing to the ease with which extracted honey can be

adulterated, likewise prevents a quantity of wax from finding its way to the market as such.

In consequence of the inability of European and other countries where modern methods of bee-culture are practised, to meet the increasing demands of manufacturers for this product, the markets have come to depend more and more for their supplies on countries where the wax produced by wild bees is collected and exported. This industry is at the present time attracting a considerable amount of attention, especially in Eastern, Central, and Western Africa, and for that reason it is of interest to give some account of the methods adopted in preparing beeswax for the market.

Wild wax seldom equals the cultivated product in quality, and this is frequently due to careless methods of preparing it for export, and to adulteration. By paying more attention to the few simple details connected with the process of preparing beeswax for export, it would be possible to produce wax from wild bees almost equal in quality to the European article and which would command a similar price on the market.

There are several methods of "rendering" wax, as the process of separating wax from honey and impurities is termed, and in some countries special appliances are in use for this purpose. In many cases, however, these appliances are too delicate or too complicated in structure for native use and in such countries one or other of the following simple methods is recommended.

The melting of beeswax can be effected either by using sun heat, direct fire heat, boiling water or steam. In a melted state beeswax readily separates from such foreign substances as may be contained in it, and owing to its lower specific gravity will float on the surface of the water.

A simple method of rendering wax, and one formerly adopted by bee-keepers in this country and elsewhere, is to extract as much honey as possible from the comb, first by draining and then by pressure in a press of the ordinary copying-press type, and finally by melting it in presence of water, which dissolves out any residual honey which may cling to the pressed wax. While melted, the wax is strained through calico to remove solid impurities, and is finally re-melted over a fire to remove

water, after which it is poured into moulds to set. Care is required in carrying out the final melting as burning may occur, and when this happens a dark-coloured wax of low market value is produced.

Another method followed by bee-keepers who have not adopted modern appliances is to place the comb, after the honey has been extracted, in a canvas bag, which is kept below the surface of water, contained in a copper or other large vessel, by being weighted with stones. If the comb contains "brood" it is allowed to soak in water for twenty-four hours before being placed in the copper, the object being to fill the dry cocoons with water, which will prevent them absorbing the melted wax. The water in the copper is next heated, and as the wax melts it passes through the canvas bag and rises to the surface of the water, leaving behind in the bag all solid impurities. The bag is taken out of the copper and squeezed between two pieces of wood to extract as much wax as possible, and the surface of the melted wax in the copper is frequently skimmed to remove scum and other impurities. A cloth is then thrown over the vessel, and the wax and water allowed to cool as slowly as possible. The wax solidifies into a cake, which can easily be removed from the water. On the under side of the cake there is usually a discoloured layer containing impurities, and this is scraped off and worked up with the next batch of crude wax. The remainder is broken up into small pieces, re-melted and poured into moulds to set. Provided that care is taken (1) not to boil the water too fast or for too long a time, and (2) to prevent burning during the final melting, this method produces clean wax of good colour; but if either of these precautions be neglected it becomes dry and brittle, and of a brownish hue. The outfit required for the foregoing operations is simple and obtainable almost everywhere.

Of the modern appliances for rendering wax one of the simplest is the "Solar wax extractor," which is in common use in the United States, Australia, and elsewhere. This consists of a wooden box with a sloping double-glazed lid. Inside the box, and raised some distance from its floor, an inclined tin tray is fixed. The comb is placed on the tray, the lid tightly closed, and the box exposed to the sun. The temperature inside the

box rapidly rises, and when it reaches about 147° F. the wax melts and runs off the sloping tray into a vessel beneath, leaving impurities behind, caught by a wire gauze strainer. This appliance is admirably suited to warm countries, and wax obtained by its use is of good quality, and requires no further refining. It is, however, not suitable for rendering comb containing brood or other gross impurities. In treating comb of this description it is best to extract the wax by one of the methods mentioned above, and then to clarify it by means of the "Solar extractor." Most of the other appliances are provided with a screw press by means of which the wax is forced through strainers after being melted by means of hot water or steam.

PRODUCTION OF BEESWAX IN AFRICA.

There is at the present time a considerable export of beeswax from various parts of Africa, and in view of the vast extent of forest land in Africa well stocked with wild bees, this trade is capable of expansion. A race of the common hive bee of Europe, known as *Apis mellifica*, Linn. var. *Adansonii*, Latr., occurs throughout the African continent from Egypt to West Africa, and southwards to the Cape, but with the exception of the Fellaheen of Egypt, few, if any, of the African peoples have domesticated bees.

A number of samples of beeswax have been received at the Imperial Institute from British Colonies and Dependencies in Africa, and as illustrating the generally excellent quality of the material obtainable, the following tabular statement of the results of their examination and valuation may be given (p. 27).

From several of these countries beeswax is exported already, and in all of them bees are stated to be abundant, so that there is room for the development of this industry. It is scarcely worth while to refer in detail to the production of wax in each of these and other African Territories in which this industry is carried on, or is susceptible of development, and in the following pages reference is only made to a few countries in which developments have recently occurred, or in which the industry is especially well organised.

Country of Origin.	Specific gravity at 99°/15° C.	Melting point. °C.	Saponification value.*	Acid value.*	Ester value.*	Moisture	Ash.	Matter soluble in water.	Matter insoluble in chloroform.	Valuation per cwt.	Date of valuation.
						Per cent.	Per cent.	Per cent.	Per cent.	£ s. d.	
Nyasaland Protectorate	—	—	—	—	—	—	—	—	—	6 17 6 to 7 0 0	February 1904
Imported to Sudan from Abyssinia	—	—	—	—	—	—	—	—	—	6 0 0	October 1905
Bahr-el-Ghazal, Sudan	—	—	—	—	—	—	—	—	—	7 0 0	March 1906
Sudan	0·821	66°	84·6	20·6	64·0	1·35	0·42	1·20	0·60	—	—
Southern Rhodesia	—	—	—	—	—	—	—	—	—	6 12 6 to 6 15 0	October 1907
Gold Coast Colony	0·829	64·5°	90·8	20·5	70·3	Nil	0·16	0·28	1·10	6 15 0	December 1908
Uganda Protectorate	0·82	63·2°	92·4	18·6	73·8	0·6	0·08	—	—	6 12 6	January 1909
Commercial beeswax	0·822	63°–64°	90 to 95	19 to 20	71 to 75	—	—	—	—	6 5 0 to 7 0 0	February 1909

* *Milligrams of potassium hydroxide per gram of wax.*

German East Africa.

During recent years much attention has been devoted to the subject of beeswax production in German East Africa, and as a result beeswax now ranks high as an article of export from that Protectorate (see this *Bulletin*, p. 56). It has been observed that wild bees are attracted in large numbers by the flowers of the Ceara Rubber Tree (*Manihot Glaziovii*) and other cultivated crops. In German East Africa swarms of bees are encouraged to settle, by placing in favourable situations on the plantations, rough hives, consisting of hollow branches or tree trunks, boxes, or cleansed kerosene tins. A piece of honeycomb placed in these receptacles soon attracts a swarm, and when once the bees can be induced to settle they increase rapidly. These rough hives are quickly filled with honeycomb, which is removed at night in the ordinary way, care being taken to leave sufficient honey in the hive to encourage the bees to start building again. The comb containing brood is not taken, and special precautions are observed to prevent the natives from stealing the brood-comb, as they like to eat young bees. To "render" the wax, a modification of a process already described is adopted. The comb containing the honey is broken up, and thrown into a large vessel and carefully melted at a low temperature. The wax separates from the honey, and when both have cooled, the former rests on the latter as a solid cake. This cake is removed, the under surface, which contains impurities, is scraped off, and the remainder broken up into small pieces and melted in the presence of several times its bulk of water. Whilst in a melted state the wax is filtered through a piece of cloth and finally run into moulds. Any vessel may serve as a mould, provided its shape is such that the solid cake of wax can be easily removed.

The honey obtained from the flower of the Ceara Rubber Tree is unsuitable for food, but is fed to the bees. These eat it greedily, and use it for the production of wax, with which to replenish their hives with comb. It is estimated that a strong swarm of bees will produce from 7 to 11 lb. of wax in a year, and as the cost of collecting and preparing it for export is small there is a good return for the labour and expenditure involved.

Uganda Protectorate.

Quite recently the Agricultural Department of Uganda has taken up the subject of beeswax production in that Protectorate, and two Baganda chiefs have been sent to German East Africa to study the methods followed there, and described above, in the preparation of wax for export. On the return of these chiefs to Uganda, leaflets in English and Luganda setting forth the advantages to be derived from bee-keeping and giving instructions as to the methods of procedure for obtaining wax of good quality, were widely circulated. The men who visited German East Africa were, on their return, sent to various parts of Uganda to give demonstrations to natives in the preparation of wax, and as a result some thousands of hives have been erected and many are occupied. There is reason to believe that in the near future beeswax will form one of the staple exports of Uganda.

In a supplement to the *Uganda Gazette* for May 15, 1909, Mr. Dawe, of the Uganda Botanical, Scientific and Forestry Department, recommends the use of the old system of skep hives for wild bees. This system is already used by some missionaries in the Protectorate with good results. Native-made baskets, inverted and plastered with cow-dung and mud serve as hives, and when the bees swarm a second hive is placed on the top of the first, a small hole in the top of the first hive providing the means of communication between the two. When filled with honeycomb the top hive can easily be removed, and as only the worker bees can pass from the lower hive through the small hole into the upper, no brood comb is formed in the latter.

A leaflet in Luganda describing the skep hive is being published for distribution, and as soon as the advantages of the skep over more primitive hives are recognised, its adoption will, no doubt, become general throughout the country.

East Africa Protectorate.

In this Protectorate the subject of beeswax production for export is also receiving attention, and one of the Baganda chiefs who visited German East Africa has been loaned to the authorities for the purpose of instructing the natives in the methods to be followed.

Gambia.

Already a large quantity of beeswax is annually exported from the Gambia. This is collected in the Kombo and Fogni districts, where there are vast areas of forest land well stocked with bees. The natives collect the wax and sell it in a crude state to European merchants, who clarify it before it is exported. According to a report supplied by the Governor of the Gambia to the Imperial Institute recently, the process of clarification used is as follows: A special building known as the wax-house is provided, and in this is arranged a row of large cooking-pots with a fire-place beneath them. Fixed to the wall near the pots is a screw-press of the ordinary copying-press pattern, but with a box-like receptacle to hold the melted wax. The pots in which the wax is to be melted are half filled with water and the fires lighted. Into these pots the crude wax is thrown after being broken up into small pieces. The water is allowed to boil for about three hours, and the melted wax is then ready for the press. The press receptacle into which the wax is poured measures 21 × 26 × 26 inches, and has a lining of perforated zinc fixed at about half-an-inch from the sides. Space is thus provided for the escape of the wax and water when pressure is applied. A tube leads from the press and conducts the mixture of wax and water to a barrel placed to receive it. By means of a tap at the base of the barrel the water is drawn off from time to time, so that eventually little besides wax remains.

When using the press a layer of grass is placed at the bottom of the receptacle, and this is scalded with boiling water to prevent the wax adhering to it. A second layer of grass is arranged crossways on the first and then a layer of hot water and melted wax is poured over it from the cooking-pots. Alternate layers of grass and wax succeed this until the receptacle is full, when pressure is applied by means of the screw. Under pressure the wax is squeezed out and escapes into the barrel, leaving all impurities between the layers of grass. The melted wax is allowed to remain in the barrel for from fourteen to fifteen hours, when it is sufficiently cooled to handle, and is poured into moulds previously oiled to receive it.

INDIA.

The beeswax exported from India is the product of three species of Apis, namely: *A. dorsata*, Fabr.; *A. indica*, Fabr.; and *A. florea*, Fabr. The wax derived from each of these is practically identical in composition, but differs somewhat from European wax, chiefly in its lower acid value. The collection of wax is carried on here and there throughout India and Burma, mainly by jungle tribes, who gather it from trees and rocks. Besides entering into a number of local industries, there is a considerable amount of beeswax exported mainly to Germany, the United Kingdom, France, Belgium and the Straits Settlements. In preparing the wax the honey is first removed by squeezing the comb between the hands. It is then washed in cold water to further remove honey or other soluble matter contained in it, after which it is placed in a vessel half filled with water and heated over a fire. As a rule no attempt is made to grade the wax before melting, so that comb containing brood, eggs, twigs, leaves, grass, etc., is included in the boiling. These impurities separate from the wax when in a melted condition, and are removed by straining the wax through cotton cloth. On cooling, the wax is made into cakes or balls. A second melting is sometimes given, and turmeric powder is frequently mixed with the wax to give it a bright yellow colour. In a melted state it is poured into vessels containing a little water, which serve as moulds.

EXHIBITS OF BEESWAX AT THE IMPERIAL INSTITUTE.

Samples of refined beeswax from the Gambia, Sierra Leone, Gold Coast Colony, Cape of Good Hope, Uganda, Nyasaland, Zanzibar and Pemba, the Sudan, the Seychelles, Ceylon, Federated Malay States, Queensland, Jamaica, Dominica and Grenada are shown in the respective courts in the Public Galleries of the Imperial Institute. Specimens of the various wild bees of India and numerous samples of the beeswax produced in different parts of India are also shown in the Indian Section.

THE NATURAL VARNISHES OF CHINA AND JAPAN.

THERE are two genera of plants belonging to the natural order Anacardiaceæ, which contain species that on being tapped yield a sap largely used in Eastern countries as a natural varnish or lacquer. These are *Rhus*, which yields the "Japanese lacquer," and *Melanorrhœa*, which produces the "black varnish of Burma." The lacquer of Japan is perhaps the best known. It is characterised by its hardness, which increases with age; its lustre, which is retained under varying atmospheric influences, and its resistance to the usual agencies which attack artificial resinous varnishes such as those made with copal or shellac as a basis.

At the present time this product, so important in the East, takes practically no part in the arts and industries of European and American countries. Among Western nations the term "lacquering" is used to describe the practice of coating polished metal or metallic surfaces with transparent varnishes, the basis of which in most cases is the resin lac, from which the term is derived. The introduction of Japanese lacquer-ware to Europe probably suggested what is known as "japanning." This consists in producing black glossy surfaces on metal or wood by coating with various varnishes, which are dried and hardened at high temperatures in special stoves. The methods of procedure, materials and results, are, however, entirely different from those obtaining in Japan.

The lac-ware of India, often erroneously spoken of as "lacquer-ware," is produced by the use of lac, a resin deposited on various trees through the agency of *Tachardia lacca*, a scale insect (see this *Bulletin*, 1909, 7. 63).

The tree which yields the Japanese and Chinese lacquers is *Rhus vernicifera* DC., a deciduous species with graceful imparipinnate leaves, sometimes cultivated in this country as an ornamental tree in parks and gardens. It is native to China, and, like the art of lacquering, was introduced thence to Japan in very early times.

CHINESE LACQUER.

The varnish tree is found wild in woods, and is also cultivated along the margins of fields. Abundant in Central China, especially in the mountainous areas of Western Hupeh and Eastern Szechuan, it is rarer in Western regions. It has an altitudinal range of from 3,000 to 7,500 feet, but is most frequently met with at about 4,000 feet elevation.

The trees are the property of the owner of the soil and do not belong to the tenants who hold the land; the varnish which they yield is also claimed by the former.

When the tree has attained a diameter of about 6 inches tapping for varnish commences, and this operation is continued at intervals until the tree is 50 to 60 years of age. If the tapping is too severe or the trees too young, injury or death is liable to result. The tapping commences in June or early July, at a time corresponding with the opening of the flowers, and is continued throughout the summer. Oblique incisions from 4 to 12 inches in length and about 1 inch in width are made in the bark of the tree down to the wood, and the sap which exudes is collected in shells, bamboo tubes and similar receptacles. Pegs are driven into the trunk of the tree to facilitate climbing in order to reach the larger branches. The tapping is done early in the morning, and the sap is gathered from the receptacles into which it has flowed from the cuts each evening. At first greyish white, the varnish quickly oxidises on exposure to the air, and becomes brownish black. To prevent contact with the air it is usual to cover the crude varnish with layers of oiled paper. The sap continues to exude from the wound for about seven days, and then a fresh slice of bark is removed, which causes another exudation. This is repeated seven times with an interval of about seven days between each operation, so that the work on each tree occupies about fifty days. After being tapped the tree is allowed a period of from five to seven years to recover, and then the old wounds are re-opened or fresh ones are made.

Enormous quantities of this varnish annually pass through the port of Hankow, and this is in addition to that used locally. Chinese varnish is, however, frequently adulterated by the

addition of T'ung, or wood oil, derived from *Aleurites Fordii*, or *cordata* (see this *Bulletin*, 1907, 5. 134). Some idea of the importance of the Chinese trade in this varnish may be obtained from the following figures, which give the quantity and value of the varnish passing through the port of Hankow. The bulk of the export goes to Japan.

Year	lb.	£	Year	lb.	£
1905	2,136,400	126,778	1907	2,444,000	134,353
1906	2,093,466	113,761	1908	2,479,792	145,114

JAPANESE LACQUER.

The lacquer tree flourishes all over Japan, from the Kiushiu Islands to Yezo, but it is from Tokio northwards, more particularly between lat. 37° and 39°, that it is largely cultivated. Along the borders of valley bottoms and in recesses where rice and other crops cannot be grown, lacquer trees may frequently be seen planted. The tree is propagated either by seeds sown in January or February, or by means of root-cuttings. The cuttings are obtained by digging up the roots of trees which have been felled. Pieces of root are selected and cut into lengths of about 6 inches, and then planted in rows in beds. After a time these produce adventitious buds, from which shoots are produced. They are then planted out to form trees, and are suitable for tapping for varnish earlier than those raised from seed.

The usual age at which a tree can be profitably tapped is ten years, although in exceptional cases trees only five years of age have been tapped. The tapping operation for extracting the sap consists in making horizontal incisions in the bark of the tree, and this can be performed all through the summer from June to the end of October.

The quantity of varnish varies according to the season at which it is obtained. In spring this sap is watery, and is then the least valuable; at midsummer it is at its best; in autumn it is thick and slow in exuding.

The incisions in the bark are made by means of an iron instrument of peculiar shape. Each incision extends along about a quarter of the circumference of the tree; the bark is cut through down to the wood, and a portion is removed to leave

an open wound. The sap as it exudes from the tree collects in the incision, and is removed by means of a pointed spoon-shaped instrument and transferred to a collecting vessel of wood or bamboo. In the case of old trees or those having a rough bark, the outer portion is cut away by means of a sickle-shaped tool before the tapping knife is used. The collector makes the first incision near the base of the trunk, and continues the operation in from six to ten places at regular distances as far up as he can reach. He treats from ten to fifteen trees in this way, and then returns to the first and begins to collect the sap. After four or five days he again visits the trees, and makes other incisions between the previous wounds. This is repeated some fifteen or twenty times until the whole area of the bark is scored. An interval of four or five days is allowed between each tapping operation, during which the sap exudes, so that the work on each tree extends over a period of from 80 to 100 days. Each collector can tap from 600 to 800 large, or 1,000 small trees, during the summer season.

If the tree is to be sacrificed the tapping operations are continued on the branches. The tree is cut down, the branches lopped off and made into bundles, which are placed in water for from ten to twenty days. They are then tapped by making spiral incisions in the bark, and yield an inferior varnish, which is used for cheap articles and ground-work. In most cases the tree is left for a future yield of varnish or for a crop of fruit from which oil is obtained, and in that case a more careful system of tapping is carried out and fewer cuts are made.

Under exhaustive treatment each tree yields from 27 to 54 grammes of raw varnish during the season.

When first collected the sap is of a drab or grey brown colour, of an even viscid consistence, turning black on exposure to the air, and becoming coated with a thick tough skin.

The raw varnish, known in Japan as "Ki-urushi," is packed in wooden tubs, and protected from contact with the air by layers of oiled paper. The tubs are securely protected from damage during transport by being bound with straw ropes.

To prepare the raw varnish for use it is first strained to remove pieces of bark or similar foreign substances, and is then placed in wooden tubs and allowed to settle. The inferior

quality sinks to the bottom, leaving the thinner and finer qualities above, and these are separated by decanting. The varnish is again pressed through cotton or hemp cloths, and is then known as "se-shime." It is then ready for use as priming or for ground-work. Finer qualities are produced by pouring the better qualities of raw varnish into shallow pans of wood exposed to the sun, or over mild fire heat and constantly stirring with a paddle. This process takes usually a few hours, during which time the amount of water is considerably reduced, and the varnish assumes a syrupy consistence and a rich brown colour. Varnish so prepared is used mainly for finishing, over coats of coloured lacquer.

The colours are added to the lacquer during the process of stirring while exposed to the sun. The well-known black lacquer is produced by adding a solution of some salt of iron or of iron fillings and water. Cheaper black lacquers are composed of an inferior quality of raw lacquer mixed with the drying oil obtained from Perilla seeds (*Perilla ocymoides*).

The variety of lacquer known as "pear ground," which is used in connection with gold dust, or gold substitutes, is the most expensive. It is prepared by adding gamboge in powder or concentrated solution. An inferior kind is produced by adding Perilla oil, plum juice (*Pyrus mume*), or the yellow extract of the fruit of *Gardenia florida*. Red is produced by adding cinnabar (mercuric sulphide) or red oxide of iron and yellow by including orpiment (arsenic sulphide). Brown is obtained by mixing red and black lacquers and green by adding indigo, prepared from *Polygonum tinctorum*, to the orpiment. Various metallic powders, such as silver, gold or tin dust, or cheaper substitutes, are also sometimes mixed with the lacquers, as well as charcoal obtained from the woods of *Camellia japonica* and *Lagerstrœmia indica*.

A peculiarity of the lacquer is that it hardens only in a moist atmosphere and remains in a "tacky" condition if exposed to sunlight and heat. Its application as a varnish in China is performed only during wet weather and in Japan special chambers, cupboards or boxes are provided, which are kept moist by being washed with water before the lacquered articles are placed in them to harden. The only change which takes place in the

composition of the lacquer in drying at ordinary temperatures is the slow absorption of oxygen, finally amounting to 5·75 per cent. by weight of the original substance. Complete oxidation is found to be due to the action of an oxidising ferment, to which the name *laccase* has been applied, though quite recently the presence of a special ferment has been questioned and the absorption of oxygen has been attributed to an obscure chemical reaction depending on the presence of a compound of manganese with a proteid-like substance.

The only method of thinning lacquer known to the Japanese, other than heating it, is by adding camphor. This is employed in a granulated form and after being broken up is mixed with the lacquer by means of a wooden spatula.

Lacquer is almost invariably placed on wood as a foundation. The wood of close-grained coniferous trees is frequently used as well as those of *Magnolia hypoleuca*, *Zelkowa Keakii*, *Paulownia imperialis*, *Fagus Sieboldii* and others, with the exception of camphor-wood, which is liable to soften the lacquer. Less frequently employed as a foundation are papier-mache, horn, tortoise-shell, bamboo, copper and unglazed clay wares.

Manufacture of Lacquer Ware.

The manufacture of lacquer ware is a tedious and complicated process. Much attention is devoted to the preparation of the ground-work on which the decorations and finishing coats of fine lacquer are laid. The defects or joins in the woodwork are first made good with a kind of putty consisting of raw lacquer, rice-paste and finely scraped hemp bast or cotton lint, which is applied with a spatula and sets very hard. Sometimes the whole surface to be lacquered is covered with hemp canvas or tough fibrous paper which is fixed with a mixture of rice-paste and lacquer. Successive coats of inferior lacquer mixed with pottery dust or clay powder and rice-paste follow, and after each coat has hardened in a moist chamber it is rubbed down with sandstone or charcoal until a perfectly smooth dull surface of grey-black is produced. When the ground-work is completed the article passes to artists for the finishing processes or for decoration.

In the case of simple wares of one colour only, a coat of

coloured or transparent lacquer is given over the black ground-work, and after this has hardened in a moist chamber it is polished with hartshorn ash. In some varieties of this work the finishing lacquer is mixed with oil and this sets with a good surface and requires no polishing.

The yellow lacquered wood-ware, which shows the grain or knots of the wood in the finished article, is produced by applying a coat of lacquer coloured with gamboge or the yellow extract of Gardenia fruits and after this has hardened a coat of pure lacquer mixed with oil. When dry this has a brilliant transparent appearance and requires no polishing. A dull black surface is produced by painting the ground-work with black lacquer, which is afterwards rubbed down with wood-charcoal of *Lagerstrœmia indica.* Over this is applied a layer of fine lacquer, which when hard is rubbed down with soft paper. A lustrous black is produced by further coats of fine lacquer, each of which on hardening is polished with burnt hartshorn and finally rubbed over with oil.

In the coloured marble-like ware, known as "Tsugaru lacquer," four or more colours appear in more or less regular stripes or blotches or as an indiscriminate mixture. The manufacture of this ware requires much time and it is in consequence expensive. To produce the varied colouring a layer of putty, consisting of lacquer mixed with white-of-egg, is applied to the ground-work in such a way as to give an uneven surface. Over this are laid the coats of coloured lacquer in any desired order, followed by a layer of transparent lacquer. Each coat is hardened in the moist chamber before another is applied. The uneven surface is then ground down by rubbing with charcoal and water until perfectly smooth, and this reveals the underlying colours in proportions varying according to their depth from the surface. The final work consists in coating with transparent lacquer, which is rubbed down with charcoal when hard, and polished with rape oil and hartshorn ashes until a mirror-like surface is produced.

A type of lacquer-ware similar to that last described is known as "Wakasa lacquer." This has gold and brown colouring in addition to the black, red, yellow and green used in "Tsugaru-work." "Wakasa lacquer" is sometimes ornamented by having

scroll or geometrical designs impressed on the soft albuminous ground, or in some cases small sprays of a coniferous plant are pressed into it and are removed when it has set. Over the uneven surface thus formed successive coats of coloured lacquer are applied, and before the last coat has quite hardened gold leaf is laid on and adheres firmly to every part. Several coats of transparent lacquer are then given until the depressions are filled. The usual rubbing down with charcoal follows, a process which removes the lacquer from the highest points and reveals the underlying gold leaf outlined with the colours previously applied. The rich brown colour is produced by the gold lying at various depths beneath the transparent lacquer.

Modifications of this work are produced by laying successive flat coats of coloured lacquer on a smooth ground and then cutting or rubbing away the upper layers with charcoal to reveal those beneath as may be required by the design.

In the decoration of lacquered articles glistening metallic dust or pulverised mother-of-pearl shell are frequently employed. These are placed in cylindrical tubes formed of a portion of reed or bamboo, one end of which is covered with fine muslin, which acts as a sieve. The whole surface of the article or a definite stencilled design is then coated with lacquer and before this has hardened the dust is sprinkled on it by means of a sieve. It adheres to the moist lacquer surface, and when this has hardened several additional coats of transparent lacquer are applied and ground down and polished in the usual way so that the dust appears embedded in the smooth lacquer surface.

Frequently designs in colour are introduced on plain lacquered backgrounds. The design to be coloured is first painted on a sheet of tough paper and transferred to the article by pressure of the hand. The paper is easily removed by simply warming the lacquer. The design is then filled in by means of a fine hair pencil dipped in lacquer, and the various colours applied in the form of dry powder by means of a pad or brush. Several coats of transparent lacquer are then placed over the colours and when hard the usual rubbing down and polishing take place.

A common method of decorating lacquered ware is by inlaying with mother-of-pearl shell. In the best work this is very sparingly employed. But in the common ware largely exported to

Europe large designs are carried out in this material. Thin pieces of selected shell are cut to the necessary shape, painted on the back and covered with tinfoil. They are then fixed in the position they are to occupy in the design, and the article receives several coats of transparent lacquer. The usual rubbing down and polishing takes place after the lacquer has hardened and the shell appears on the surface brilliantly polished and its colour enchanced by means of the tin foil.

In relief work, which is often done on a gold ground, the design is first sketched in outline and left till the ground-work is finished. A putty composed of lacquer, lamp-black, white-lead and camphor, is then laid over the design by means of a wooden spatula and roughly modelled into shape. When hard this is finished by being carefully rubbed and ground with charcoal. A coat of lacquer is then applied and metallic or coloured powders sprinkled on in the manner already described. These are covered with several coats of lacquer and finally rubbed down and polished. The art of carving lacquer is of Chinese origin and is usually carried out in the rich red ware known as "Pekin lacquer."

An account of the production and use of Burmese black varnish or lacquer will be published in the next number of this *Bulletin*.

CULTIVATION AND UTILISATION OF SOY BEAN—II.

IN a recent number of this *Bulletin* (1909, 7. 308), an account was given of the cultivation and utilisation of the soy bean, and reference was made to the suggestion by the Imperial Institute as to the possibility of growing this crop in the Colonies and India.

A study is now being made by the Reporter on Economic Products to the Government of India of the composition of soy beans of established Indian races, with a view to the determination of the proportion of oil which they contain as compared with that contained in Manchurian beans. The quantity of soy

beans at present produced in India is not sufficient for the creation of an export trade, but there is ample evidence that the beans could be grown extensively if desired.

The introduction of the soy bean into India is of comparatively recent date and the product is not grown to any large extent except among people of Mongolian races and particularly in Burma. Experiments on the cultivation of the plant have been carried out at various times at Nagpur, Lahore, Madras, at several localities in the Bombay Presidency, and at Saharanpur in the United Provinces. Further experiments, however, are required in order to prove that the crop would be remunerative before it can be safely recommended to the ryots. Reference to small trials recently carried out in the Central Provinces has been made in the Annual Report on the Agricultural Stations for 1908-09 (see this vol., p. 70).

Results of the analysis of fourteen samples grown from seed of Japanese origin at the Manjri Experimental Farm are recorded in the *Indian Trade Journal* (1909, **15**. 145) and show that the products were of good quality and usually contained a satisfactory proportion of oil, six of them yielding more than 20 per cent. It is therefore considered that further efforts are justified to establish soy bean cultivation in India as a commercial industry.

With regard to the possibility of growing the crop in West Africa, it may be mentioned that supplies of the seed were forwarded last year to the Governors of the various Colonies by the late Sir Alfred Jones, and the following results have been already reported. Experiments carried out at the Agricultural Station at Olokemeji, Southern Nigeria, have indicated that the crop can be grown there satisfactorily, but it is considered doubtful whether the farmers would take up the cultivation of a product of such low commercial value. Some of the beans were sown at Axim in the Gold Coast and germinated in three days. Trials are also in progress at Abuko in the Gambia.

The following information has been supplied to the Imperial Institute in response to letters to the Departments of Agriculture in South and East Africa, pointing out the demand which has arisen for soy beans, and asking for opinions as to the possibility of growing them for export in their respective Colonies or Protectorates.

It is considered that the bean could probably be grown with success in the Cape of Good Hope, but the crop would not prove very remunerative on account of the high cost of labour. An extensive trial, however, will, if possible, be carried out in the West of the Colony.

Attempts are being made to encourage the cultivation of the crop in Natal, but since the beans find a local market at 3*d.* per lb., it is not possible that an export trade can be established until a more extensive area is devoted to the product. The soy bean forms the principal leguminous crop of the Cedara Experiment Farm; twelve acres were planted during last season, and the best variety yielded 513 lb. of seed per acre.

The cultivation of this crop is regarded as a promising industry for the East Africa Protectorate. Two tons of seed have been forwarded, and trials are now in progress.

Soy beans are already grown by several planters in Nyasaland as a green manure in the coffee plantations, but, owing to the present high rates of transport, it is not considered likely that the crop could be grown profitably for export.

The cultivation of the bean would probably prove successful in Rhodesia, and a supply of seed is being forwarded for purposes of trial.

A small consignment has been sent by the Imperial Institute to the Sudan for experimental cultivation on the Government Farm at Khartoum.

Two samples of soy beans have recently been forwarded for examination to the Imperial Institute from Wei Hai Wei, and have been found to be of ordinary quality and to contain about 17 per cent. of oil.

It is reported that attempts have been made to grow soy beans in Canada, but hitherto without much success.

In a recent issue of *Milling* it is stated that soy bean flour is being sold for bread-making, and it is recommended that one part of this material should be mixed with four or five parts of wheat flour. A loaf made from such a mixture had a pleasant flavour, but the top of the loaf broke easily. The bread had a brown colour, and as soy bean flour cannot be bleached, it is evident that it could not be used for white bread. Soy bean flour is also being employed in the manufacture of biscuits.

PRICKLY PEAR AND ITS UTILISATION.

THE plants known as "prickly pears" are members of the cactus family, including various species of *Opuntia* and allied genera, and usually bear sharp thorns and spines. A short account of these plants, with special reference to their utilisation as feeding-stuffs for cattle, has already been given in this *Bulletin* (1908, 6. 314).

In Australia, the Cape of Good Hope, Texas, and many parts of India, the prickly pear has overrun immense tracts of country, and its eradication has become a problem of the greatest importance. The plant spreads very rapidly; the seeds are eaten and disseminated by birds and other animals, and if a joint is broken off and falls to the ground it readily takes root. Owing to the urgency of this question in Australia, the Governments of New South Wales, Victoria and Queensland have enacted legislation to provide for the destruction of the plant. Enormous areas of good agricultural and pastoral land have been rendered useless, and the cost of eradicating the pest is in most cases greater than the actual value of the land when cleared. In Queensland, the cost of clearing has ranged from £5 to £15 per acre. In 1907, the Queensland Government offered a conditional reward of £10,000 for the discovery of an effective method of destroying the pest. In the Cape of Good Hope, a Select Committee appointed by the Legislative Council reported in 1890 that the prickly pear had spread to an alarming extent, especially on good land, depreciating the value of the land in certain districts by as much as 50 per cent.

The destruction of the prickly pear can be effected by cutting down the plants and digging out the stumps, piling them in heaps to dry, and afterwards burning them. A better plan is to bury the plants at a depth of at least three feet. Probably the most effective means of extirpating the pest, however, is to spray the plants with a solution of sodium arsenite. It is said that, after this treatment, the leaves rapidly wither and turn brown, and in a few weeks have decayed to such an extent, and have become so dry, that they can readily be burned. Although the roots are not killed by this method, there is little danger of the plants shooting again after the sub-aerial parts have been

destroyed by fire, and any that may do so can easily be removed. In order to make the spraying as effective as possible, it is advisable to puncture the plants on all sides with a fork before applying the poison.

As would naturally be expected, considerable attention has been directed to the possibility of utilising the plant in some way, so that instead of being a mere pest it might become a product of economic value, and many requests have from time to time been addressed to the Imperial Institute for information on this subject. The present article has, therefore, been written with the object of indicating some of the principal uses which have been suggested and of discussing the likelihood of their proving remunerative.

The fruits of some species of prickly pear are used as food, the thorns being first rubbed off with a cloth. In some parts of India and the United States of America the plants are grown for hedges or fences. Some species are employed for horticultural purposes and prove very effective, especially in rockeries. In Mexico and the Canary Islands, the prickly pear forms the food-plant of the cochineal insect (*Coccus Cacti*). In certain districts of Mexico, the young, fresh joints of the plants are used by the inhabitants as food, whilst the dry stems and joints are employed as fuel. Such fuel, however, is of very poor quality, but is useful in localities in which better fuels are scarce.

In 1908, the remarkable announcement was widely published that a chemist in Brisbane had discovered valuable commercial possibilities for the prickly pear, which led him to conclude that, instead of the plant being ruthlessly destroyed, its cultivation ought to be encouraged. The principal claims put forward were (1) that from one ton of prickly pear seven gallons of alcohol could be prepared at a cost not exceeding 3*s.* 6*d.* per gallon, whilst the refuse could be made into a nutritious cattle-food; (2) that the plant yields an excellent sugar, two tons of prickly pear yielding as much sugar as three tons of sugar-cane, and of equal quality; and (3) that the fibrous nature of the material renders it suitable for the manufacture of paper, straw-board and other articles, and that these could be more cheaply produced from prickly pear than from any product now used for the purpose.

The suggestion with regard to utilising the plant for the manufacture of alcohol is not new. Proposals of this kind have been made previously in New South Wales, Mexico, Spain, India, and other countries, but it does not appear that alcohol has ever been obtained from this source on a commercial scale. The juice of the fruit contains saccharine matter, and undergoes spontaneous fermentation ; the alcoholic liquid thus obtained is used by the natives of Mexico and other countries as a beverage. It seems improbable, however, that this liquid could be profitably employed as a source of alcohol, for the following reasons.

Alcohol of 90 per cent. strength can be manufactured from cheap materials, such as maize and potatoes, at a cost of from *6d.* to *1s.* per gallon, depending on the market price of the raw materials and other local factors. It is evident, therefore, that the production of spirit from prickly pear juice could only be remunerative in a country which had no other crops available for the purpose and which had a heavy duty on imported alcohol. Moreover, the researches of Ulpiani and Sarcoli in 1902 have shown that not only would the manufacture of alcohol from prickly pear juice be unprofitable, but also that it is scarcely practicable. These chemists found that the juice of the fruit of the prickly pear contains 12·8 per cent. of sugar, which consists not of sucrose (or cane-sugar), but of a mixture of glucose and fructose. The spontaneous fermentation of the juice is due to the action of a natural yeast which occurs on the fruit, and has been termed *Saccharomyces Opuntiæ.* This yeast does not ferment cane-sugar, but only glucose and fructose. The fermentation takes place very slowly, and even after a long time the proportion of alcohol is not equivalent to the amount of sugars originally present. Added yeast, however, is rapidly suppressed by *S. Opuntiæ*, and it would therefore be necessary to kill the latter by sterilising the juice before introducing the ordinary yeast. On account of the expense of sterilisation, it is regarded as desirable to find a yeast capable of producing alcohol rapidly in the presence of the natural yeast (*S. Opuntiæ*), as only in this way could the manufacture of alcohol from the juice become practicable.

With regard to the manufacture of sugar from the prickly pear, it is obvious that if the contention of Ulpiani and Sarcoli

that the juice contains only glucose and fructose is correct, no cane-sugar could possibly be obtainable.

With reference to the utilisation of the prickly pear for paper-making, experiments at the Imperial Institute have shown that a pulp can be prepared by the process of heating the fibre of the plant with caustic alkali under pressure, but that the product so obtained consists of very short fibres (about $\frac{1}{80}$–$\frac{1}{30}$ inch long), and would therefore be of comparatively low value. Samples of the fibre of a South American species (*Opuntia Dillenii*), which occurs in India, were shown at the Colonial and Indian Exhibition which was held in London in 1886. Paper-makers who examined these samples, however, regarded them as worthless in comparison with other cheap and plentiful materials. It is probable that the collection of the raw material would be a costly operation. Moreover, a little consideration will show that an immense quantity of the plant would have to be dealt with in order to produce a comparatively small amount of paper-pulp. Analyses of various parts of the prickly pear at different ages in the United States of America (*Bureau of Plant Industry, Bulletin No.* 102, *Part I., United States Department of Agriculture*, 1907) have shown that, on the average, the fresh plant contains 84·3 per cent. of water and 2·4 per cent. of "crude fibre." Experiments at the Imperial Institute have proved that 100 parts of dry prickly pear fibre yield about 42 parts of dry paper-pulp. Hence from 2·4 parts of the crude fibre about 1 part of pulp could be obtained. It is true that the "crude fibre" of the analysis was extracted by a different process from that used in the preparation of the fibre employed in the Imperial Institute experiments, but this would not greatly affect the results arrived at. It is evident, therefore, that for the manufacture of one ton of paper-pulp it would be necessary to cut about 100 tons of the fresh plant. When to the cost of collecting and handling this mass of material is added that of the chemicals and labour required for the extraction of the fibre and its conversion into paper-pulp, it seems evident that the project could not possibly be remunerative, especially as the product is of low quality and would not in any case be worth more than a few pounds per ton.

In conclusion, it appears that the only purpose for which the

prickly pear could be used successfully is as a cattle food. Opinions with regard to the value of the material for this purpose are, however, very conflicting, and, at best, it would constitute a product of somewhat low nutritive value, and could only be used in conjunction with richer feeding-stuffs, such as wheat bran or cotton-seed meal. In the previous article on this subject (this *Bulletin*, 1908, p. 314) allusion was made to the production of a spineless variety of prickly pear in California. It does not appear safe, however, to encourage the cultivation of such forms until they have been subjected to prolonged trials, especially as there is always a danger that they may revert to the spiny condition. Trials have been made recently in South Africa with so-called spineless varieties, which have proved to be not altogether spineless, but are, nevertheless, regarded as much superior to the ordinary spiny forms as a feeding-stuff for cattle.

NEW RUBBER-YIELDING PLANTS IN MEXICO.

THE principal sources of rubber in Mexico at the present time are the Central American rubber tree, *Castilloa elastica*, and the Guayule plant, *Parthenium argentatum*. *Castilloa elastica* is indigenous in the forests of Southern Mexico, and is being largely cultivated in the country, the plantations already established amounting to 125,000 acres. The Guayule plant is a small shrub which grows over large areas of desert country in Northern Mexico, and since the discovery several years ago of its value as a source of rubber it has been exploited on an extensive scale. It is thought, however, that at the present rate of consumption the supplies of the wild Guayule plant will be exhausted in a very few years. The production of rubber in Mexico from wild and cultivated Castilloa trees amounted to nearly 5,000 tons in 1908, whilst during the same period about 4,500 tons were obtained from Guayule plants. Almost the whole of this rubber is sold in the United States, and very little reaches Europe.

A short time ago another rubber-yielding plant, known as Palo amarillo, was discovered in Mexico, and more recently

the existence of a number of others has been announced by Dr. Pehr Olsson-Seffer, of Mexico City. The following information regarding these plants, which has been supplied to the Imperial Institute by Dr. Olsson-Seffer, will be of interest.

The Palo amarillo tree, also known in Mexico as Palo colorado, Papelillo and Cucuracho, is a new species of Euphorbia, which has been named *Euphorbia fulva*, Stapf. It occurs in the dry semi-tropic zone on the slopes of Sierra Madre at an elevation of 900 to 4,800 feet, and extends southward from Durango to the southern part of Oaxaca along the Pacific coast. It grows on rather poor rocky or sandy, volcanic soil and attains a height of from 20 to 34 feet with a trunk diameter of 7 to 12 inches. Where most numerous the trees average 28 to the acre, but as many as 92 per acre have been counted.

The tapping of the tree presents some difficulty, and the best method has not yet been determined. The latex from the stem contains from 7·3 to 15·7 per cent. of caoutchouc, and from 19 per cent. upwards of resins, whilst the latex from the branches only contains from 3 to 6 per cent. of caoutchouc. The coagulation of the latex is not easily accomplished, and the product obtained is of inferior quality on account of its resinous character and its low tensile strength; the yield is also very low. The rubber would have approximately the same value as guayule rubber, *i.e.* about 1*s.* 3*d.* per lb., with fine hard Para at 3*s.* per lb., or 4*s.* per lb. with fine hard Para at about 9*s.* per lb.

It has been suggested that the rubber might be extracted from the plant by mechanical means, but this would involve the cutting down of the trees, and as they are not very abundant and take about 10 years to mature, this procedure would rapidly result in their extermination. On the whole the possibilities of the Palo amarillo tree as a source of rubber are not considered very promising.

The new rubber-yielding plants discovered by Dr. Olsson-Seffer are species of Plumeria, Jatropha, and Euphorbia.

The Plumerias are known as Cacaloxuchitl by the natives, and it seems probable that three allied species are included under this name, principally *Plumeria rubra*, but probably also *P. acutifolia* and *P. mexicana*. The plants occur over considerable areas in many parts of Central and Southern Mexico,

at elevations of 500 to 7,000 feet, and are found on dry hillsides as well as along creek banks, flourishing best in sandy loam full of rocks and pebbles. The number of wild plants varies from 20 to 175 per acre. The average height is about 12 feet, some specimens attaining over 20 feet, and the circumference ranges from 6 to 18 inches at three feet from the ground. The plants are easily propagated and can be exploited for rubber when three years old.

The latex, which can be obtained by tapping the stem in the ordinary way, flows principally from November to February. The yield of rubber from the latex varies greatly up to 24 per cent., 14 to 16 per cent. being the average figure. As much as 1 lb. 13 oz. of rubber has been obtained from a single tree by tapping, but usually the yield is much less. It has, however, been found that the young branches are very rich in latex, which contains a fair percentage of rubber, and it is suggested that the best method of exploiting the trees will be to prune them periodically and to extract the rubber from the young shoots by special crushing and maceration processes. Experiments have shown that pruning, if carefully performed, does not injure the tree.

The rubber obtained from these Plumerias is of fair quality. A specimen prepared by direct coagulation of the latex was found to contain 0·75 per cent. of moisture and 13·4 per cent. of resin, whilst a specimen which had been specially purified by chemical methods contained in the practically dry material 3·1 per cent. of resin and 2·2 per cent. of proteid. The rubber as at present produced is rather soft, but it is hoped to improve it by careful preparation. The specially purified material was valued at about 3*s.* per lb. with fine hard Para at 4*s.* per lb.

Another plant which is of interest as a possible source of rubber-like material is known as Mala mujer, and has been identified as *Jatropha urens.* This plant is a tall shrub which is found in great quantities over large areas of Southern Mexico, intermingled with the above-mentioned Plumerias. The product obtained from it is intermediate in character between rubber and gutta percha, and may be suitable for insulating and other purposes. The latex does not flow freely and the material would have to be obtained by mechanical or chemical treat-

ment. Another species of Jatropha, which has not yet been identified, is common in many parts of Southern Mexico, and the latex is stated to yield rubber of good quality.

Two species of Euphorbia have also been investigated as possible sources of rubber. One of these *Euphorbia calyculata*, H.B. & K., commonly known as Chupire, Chupireni or Chupiri, occurs in the highlands of the State of Michoacan, especially in the Chapala basin, and it is also found in the States of Jalisco and Guerrero. It is a tall branching shrub, the latex of which flows freely and contains about 21 per cent. of rubber of good quality.

Another Euphorbia, known as Vara Leche, and apparently closely related to *E. californica* or *E. Hindsiana*, was found to be of very little importance as a source of rubber.

In the State of Oaxaca a small Euphorbiaceous plant known as Cordoban (*Pedilanthus tomentellus*) has been found to contain a small amount of rubber, which could be extracted by the same methods as are at present employed for the Guayule plant. Another species of Pedilanthus, *P. Pringlei*, Rob., occurring in Oaxaca also contains rubber.

ECONOMIC DEVELOPMENT OF GERMAN PROTECTORATES IN AFRICA.

FROM time to time reference has been made in this *Bulletin* to the steps taken to utilise the natural resources of German Protectorates in Africa, and to developments of planting enterprise there. Information of this kind is of general interest in this country and in the British African Colonies for several reasons. In the first place all the German territory in Africa is contiguous with British possessions, and consequently the problems which confront the administrator, the agricultural or forestry officer and the planter are often identical in the two groups of territories. Further, the raw materials required by Germany are in large measure the same as those required by British manufacturers, and consequently the supplies of raw materials required from German Protectorates are very

much the same as those needed in this country. For these and other reasons, developments in British and German African territory must often proceed on parallel lines, and the information acquired as the result of experiments in one, must always be of interest to the other.

A number of reports have been published recently in Germany dealing with developments in the oversea possessions of that country, and the opportunity is taken of giving a summary of the most important of these in this *Bulletin*. Further information on the same subject will be found in previous issues, especially 1903, 1. 124; 1904, 2. 249; 1906, 4. 229, 285; 1907, 5. 24, 422; 1908, 6. 157; 1909, 7. 198.

The four German Protectorates in Africa were all acquired during 1884 to 1900, and these with her possessions in the Pacific, amount in all to 1,027,620 square miles, made up as follows: German East Africa, 384,180; German South-West Africa, 322,450; Cameroons, 191,130; Togoland, 33,700; and Pacific Islands, 96,160.

The total value of the exports of the German possessions in 1907 was 41·17 million marks, made up as follows: Cameroons, 15·89; German East Africa, 12·50; Togoland, 5·92; South Sea Islands, 5·24; German South-West Africa, 1·62. The chief items were:—

	Million Marks.		Million Marks.
Oils and oilseeds	11·38	Rough fibres	2·16
Rubber	10·77	Cotton	0·46
Animal products	5·96	Tanning materials	0·16
Foodstuffs	3·43	Copper ore	1·28

Three of these products, viz. cotton, rubber and cocoa, are of special interest, and the development of trade in these may be referred to in some detail.

COTTON.

Following the United Kingdom and the United States, Germany ranks third in the list of countries engaged in cotton manufacture, and the value of German imports of raw cotton rose from 231·0 million marks in 1897 to 515·4 million marks in 1907. The world's cotton crop in 1906 was estimated at 19·9 million bales, the United States producing 13·0, British India 3·7, Egypt 1·4, and other countries 1·8 million bales. The dis-

advantage of this dependence on foreign countries for supplies of cotton was first clearly realised by Germany, and the Kolonial-Wirtschaftliche Komitee in Berlin despatched in 1900 to Togoland the first "cotton expedition," an example which was quickly followed by other European manufacturing countries —the British Cotton Growing Association being formed in Manchester, the Association Cotonnière Coloniale in Paris, and similar associations in Italy, Portugal, Belgium and Holland. As a result of the Togoland expedition, cotton cultivation was started there on a considerable scale, and the value of the exports of cotton from Togoland amounted to 37,837 marks in 1903, and rose to 230,888 marks in 1907. In 1902 cotton cultivation was started in German East Africa, and the value of the exports of cotton from this Protectorate has risen from 7,313 marks in 1903 to 224,533 marks in 1907.

RUBBER.

The rise in the value of the exports of rubber from German Protectorates in Africa is shown by the following figures:—

	1903. Marks.	1907. Marks.
Cameroons	2,247,000	7,641,124
German East Africa	1,994,000	2,039,475
Togoland	639,995	1,094,517

Almost all the rubber is derived from plants wild in the forests. There are rubber plantations, but these in 1906 occupied only 200 acres in Togoland, 1,750 acres in the Cameroons, and 3,125 acres in German East Africa, and as yet have scarcely had time to yield.

COCOA.

Germany consumes more cocoa than any country except the United States, and as most of the cocoa grown in the German Colonies is imported to Germany, the rise in value of the exports of cocoa from her colonies, as shown in the following table, affords another instance of progress towards independence of foreign supplies.

	Togoland. Marks.	Cameroons. Marks.	German East Africa. Marks.	South Sea Islands. Marks.
1900	37	333,989	—	1,862
1904	8,911	1,043,604	308	21,543
1907	50,928	2,704,260	6,952	117,505

Some account may now be given of the developments which have taken place in the various Protectorates.

TOGOLAND.

The total value of the exports in 1907 was 5,915,609 marks, made up as follows:—

	Marks		Marks.
Maize	1,198,804	Cocoa	50,928
Rubber.	1,094,517	Groundnuts	39,418
Palm kernels	981,418	Cassava	32,136
Palm oil	417,998	Shea butter	12,783
Cotton	230,888	Copra	11,214
Ivory	131,393		

The exports of maize rose from 38,945 marks in 1904 to 433,838 marks in 1906, and 1,198,804 marks in 1907, the exceptional rise in the latter year being due to the opening of a railway from Lome to Palime. Maize is grown extensively in the Lome and Anecho districts, and is imported to Germany for use as cattle food, and for the preparation of human food in various forms.

Forest products had hitherto always headed the list of exports, and they have not yet ceased to be the main source of wealth, the oil palm being plentiful in Southern Togoland, while the wild rubber plants *Landolphia* spp. and *Ficus Vogelii* are still fairly common in parts of the hinterland, and the "Shea Butter" tree occurs in the steppe country of the interior; but forest products are gradually being overtaken in the list of exports by cultivated crops, particularly maize, cotton, cocoa, and groundnuts. Crops grown extensively by the natives for food are maize, cassava, and coconut in Southern Togoland; yam, sweet potato, and rice in Central Togoland, and the millets, *Sorghum* and *Pennisetum*, in Northern Togoland.

Experimental plantations have been formed containing, among other plants, those yielding the tanning materials "quebracho wood" (*Aspidosperma Quebracho*) and "barbatimao bark"

(*Stryphnodendron Barbatimao*), the Carnauba wax palm (*Copernicia cerifera*), planted in view of the demand for this wax in various industries, and three species of *Manihot*, viz. *dichotoma*, *piauhyensis* and *heptaphylla*, all expected to prove superior to *M. Glaziovii* as rubber producers. Seeds of "Odum," *Chlorophora excelsa*, have been obtained, though not easy to collect, and have germinated freely, and as the young plants do well in almost any soil, the planting of this valuable timber tree is to be tried for re-afforestation purposes.

CAMEROONS.

The total value of the exports in 1907 was 15,891,418 marks, made up as follows:—

	Marks.		Marks.
Rubber	7,641,124	Timber	94,785
Palm kernels	2,853,859	Kola nuts	21,397
Cocoa	2,704,260	Copal	3,149
Palm oil	1,328,299	Tanning barks	2,254
Ivory	1,073,802	Ostrich feathers	1,080

Rubber, the largest item of export, is derived from *Landolphia* spp. and *Funtumia elastica*. The latter has been found to thrive best below 3,000 feet. The largest exports of the northern part of the Protectorate are palm kernels, palm oil and cocoa. The same region grows a good deal of kola nut, which passes across the frontier into the British Protectorate of Northern Nigeria. An export trade in fresh pineapples and bananas is being developed. As the climate in the more accessible parts is damp, the absence of cotton and Sisal hemp from the list of exports is not surprising. Cotton has failed in the rainy coastal belt, but the prospects are better in Adamaua and other districts of the hinterland. Unlike the eastern parts of Africa, the Cameroons has not extensive dry steppes suitable for the cultivation of Sisal hemp and other fibres. The Ossidinge mineral district has mica, salt, and petroleum deposits.

GERMAN SOUTH-WEST AFRICA.

The total value of the exports in 1907 was 1,615,661 marks, consisting of the following chief items:—

	Marks.		Marks.
Copper ore	1,282,515	Guano	12,000
Hides	134,628	Wool	6,777
Ostrich feathers	40,542	Forest and agricultural products	1,966

Abnormal conditions still prevailed, the war having reduced the number of cattle and disorganised transport and agriculture. Copper ore, by far the most important product, contributed no less than three-quarters of the total exports. The value of the export of copper ore rose from 400 marks in 1899, to 46,877 marks in 1906, and 1,282,515 marks in 1907, the sharp rise in the latter year being due to the opening at the end of 1906 of a railway to the Otavi copper mining district. Other minerals, coal near Keetmanshoop, iron, diamonds, and marble still await development.

This is the only large German Protectorate that exports no tropical products. Forest stations in various parts of the Protectorate are cultivating experimentally, dry-country crops such as tagasaste, Australian salt-bush (*Atriplex semibaccata*), Peruvian quinoa (*Chenopodium Quinoa*), tobacco and canaigre (*Rumex hymenosepalus*); and dry-country forest trees, *e.g.* Peruvian pepper-tree (*Schinus molle*), *Prosopis juliflora*, *Robinia pseudacacia*, *Acacia cyanophylla*, *A. saligna*, *Eucalyptus rostrata*, *E. resinifera*, *E. corynocalyx*, *Casuarina tenuissima*, *C. muricata*, *Ailanthus glandulosa*, cork oak (*Quercus suber*), Mulberry (*Morus alba* and *M. nigra*), *Cupressus sempervirens*, *C. horizontalis*, *C. pyramidalis*, *Pinus canariensis*, *P. halepensis*, *P. pinea*, and *P. pinaster*.

GERMAN EAST AFRICA.

The total value of the exports in recent years has been as follows:—

	Marks.
1900	4,293,645
1904	8,950,565
1907	12,500,179

In 1893 the Kolonial-Wirtschaftliche Komitee started the cultivation of Sisal hemp; in 1898 a first crop was obtained; in 1905 the value of the export of this product reached 1,071,296 marks, and in 1907 Sisal hemp headed the list of exports. This has thus been the first cultivated crop in German East Africa to exceed in value as an export, like maize in Togoland, forest products, such as indigenous rubber, beeswax, and copal, requiring no cultivation, and only needing to be collected.

The chief exports in 1907 were of the following values:—

	Marks.		Marks.		Marks.
Sisal hemp	2,161,685	Rice	141,349	Molasses	37,660
Rubber	2,039,475	Copal	138,918	Gold	31,333
Hides	1,898,045	Sesamé	131,367	Sorghum	28,822
Beeswax	1,471,348	Horns	122,066	Coir and other fibres	24,598
Copra	1,344,781	Cattle	110,478	Maize	21,189
Ivory	663,397	Groundnuts	82,444	Cocoa	6,952
Coffee	540,093	Mica	68,024	Coconut	5,495
Cotton	224,533	Tobacco	60,504	Cassava	3,652
Dairy produce	178,874	Tanning materials	38,671		

Bees' nests are exceedingly common on trees in the forests especially near Tabora, and the value of the export of beeswax rose from 138,489 marks in 1903 to 1,471,348 marks in 1907. The value of the export of coffee is steadily increasing. West Usambara is apparently ceasing to be the chief coffee-growing district, while coffee plantations are being extended on Mount Kilimandjaro, on the Meru mountains, and near lake Nyasa, and most of all in the Bukoba district west of the Victoria Nyanza.

Two-thirds of the total exports of cotton of the Protectorate were grown by the natives, as the large European undertakings are not yet fully at work. The three chief cotton districts are Rufiji, Kilwa, and Bagamoyo. In the Rufiji delta, cotton cultivation is now being taken up actively both by natives and Europeans. In all parts, and especially in the southern portions of the Protectorate, "Mitafifi" is the variety most grown. Inland, the lake Rukwa region, where cotton has long been grown by the natives and woven by them with primitive appliances into cloth for their own use, has the great advantage of well-marked seasons, which other districts have not; the cotton crop is often seriously injured in the coast districts by a sudden fall of rain during the "dry season."

Rice is grown in all districts, the plains of Ulanga being particularly well adapted to it, and Mwansa near the Victoria Nyanza is the greatest rice and ground-nut growing district of the Protectorate. These and maize, millets and cassava are most extensively grown by the natives in all parts to supply themselves with food. Rich deposits of fossil copal have been found recently near Bagamoyo. Oil palms occur near Lake Tanganyika. The date palm is being cultivated successfully by Arabs on hills near Tabora. The plateaux of the hinterland afford scope for the development of a pastoral

industry as soon as railways have been constructed to diminish the risks involved in the transport of live animals through the tsetse fly zone to the coast. The total area of forest reserves in the Protectorate is 555,000 acres, and some of them contain excellent timbers, such as *Chlorophora excelsa* and "African Mahogany" (*Khaya senegalensis*). In some places afforestation has been begun with teak, camphor trees, an indigenous tree named "Sambla," seeds of which have been obtained from Bukoba, and "mallet" (*Eucalyptus occidentalis*) for the production of mallet bark, used as a tanning material, and wattles used as sources of fuel and tanning barks.

GENERAL NOTES.

New Series of Selected Reports from the Imperial Institute. Part II. **Gums and Resins.**—The second part of this series of selected reports (see this *Bulletin*, 1909, 7. 200) has now been issued in the Miscellaneous Series of Colonial Reports [Cd. 4971]. It contains a selection of the most important reports on Gums and Resins, issued by the Imperial Institute since 1903. The products dealt with include gum arabic from the Sudan, Northern Nigeria, India, Uganda, Australia, and elsewhere; copals from the Gold Coast, Sierra Leone, Southern Nigeria, etc.; dammars from India and the Federated Malay States; rosin from India, benzoin from the Federated Malay States, and elemi from various African Colonies.

Mineral Survey of Southern Nigeria.—A mineral survey of Southern Nigeria has been in operation since 1903 in connection with the Imperial Institute. Reports have been published already in the Miscellaneous Series of Colonial Reports, describing the work done by the Survey in 1903–04 and 1904–05, and giving the results of the investigations at the Imperial Institute of the minerals of economic value collected by the surveyors. Reports for the years 1905–06 and 1906–07 have just been issued in the same series [Cd. 4994] and [Cd. 4995]. The first of these deals with the bituminous deposits of Lagos and gives the results of numerous analyses of samples taken from these deposits at various localities, and describes the observations made in the course of a number of shallow boring experiments. The later portion of the report gives the results of examination of lignite, lead ore, zinc ore, and limestone. The second report gives particulars of the composition of a large number of "concentrates" prepared from river sands, analyses of lignites from the various deposits of this important

fuel so far located in Southern Nigeria, and the results of technical trials of a large number of pottery clays found in the Protectorate.

Manufacture of Charcoal Briquettes in the East Africa Protectorate.—In the previous number of this *Bulletin* (1909, 7, 412) mention was made of the principal contents of the "Report on the Forests of British East Africa," by Mr. Hutchins, the Conservator of Forests in that Protectorate. In a letter to the Director of the Imperial Institute, Mr. Hutchins suggests that the attention of manufacturers in the United Kingdom might with advantage be called to the proposal contained in that report, that the manufacture of charcoal briquettes should be undertaken in the East Africa Protectorate. It is thought that there would be a ready outlet for such briquettes, as fuel for the Uganda Railway and the steamboats on Lake Victoria Nyanza, and possibly, also, for domestic fuel in Nairobi. Full information is given in the report referred to, as to the forest existing along the railway, the demand for fuel, and notes as to the probable yield of charcoal from the timber available in the forest. The usual by-products of wood distillation would be made, viz. acetic acid, acetone, wood spirit, wood creosote, and tar, in addition to the charcoal required for briquette-making. For some of these by-products there would appear to be a local market, but others would have to be exported.

Agave Fibres from India.—In a former number of this *Bulletin* (1909, 7. 8), an account was given of the characters, composition and commercial value of two samples of *Agave* fibre grown at the Hindupur Plantation, which were forwarded to the Imperial Institute by the Director of Agriculture, Madras, and were referred to as the products of *Agave rigida* and *A. americana* respectively.

Information has now been received from the Officiating Reporter on Economic Products to the Government of India to the effect that he has examined specimens of the leaves of the plants from which these fibres were obtained, and has found that whilst one specimen was accurately described as derived from *A. rigida*, the other, referred to as *A. americana*, was, in reality, the fibre of *A. Vera-Cruz.*

A New Palm-nut-cracking Machine.—Brief mention was made of the Crellin machine for cracking palm-nuts in the last number of this *Bulletin* (1909, 7. 386), in an article on the African Palm Oil industry, and since the publication of that article one of these machines has been placed on exhibition in the West African Court of the Imperial Institute.

Like the centrifugal nut-cracking machine previously referred to (*loc. cit.*), the Crellin machine is obtainable from Miller Bros., Ltd., of Liverpool.

The machine consists essentially of a pair of smooth, conical rollers,

mounted in a sloping position above a pair of longitudinally grooved conical rollers, which are carried in a horizontal position.

The nuts are fed on to the upper pair of rollers by a sloping tray, which is kept in motion by means of cams on the ends of the upper rollers. The nuts pass along the upper rollers until they reach a point where the aperture between the conical rollers becomes wide enough to allow them to fall through to the lower grooved rollers, between which the shells are cracked. The upper rollers thus serve to feed the nuts on to the lower (or cracking) rollers at a point where these latter are at a sufficient distance apart for the shells to be broken and the kernels to be left whole.

From an experiment carried out at the Imperial Institute with a few pounds of palm-nuts, it appears that this machine is somewhat slower in action than the centrifugal type. The machine is strongly constructed, simple, and seems unlikely to get out of order even with rough usage, so that it appears to be well suited for use by natives. As packed for shipment it weighs 2 cwt. 2 qrs. 25 lb.

Coca Cultivation in Peru.—The bulk of the coca leaves of commerce are obtained from Peru, with smaller amounts from Bolivia, Java and Ceylon. In recent years, owing to the increasing use of the drug, either as such, or in the form of cocaine, the demand of coca leaves in Peru has been so great that the natural forests of coca bushes are beginning to show signs of exhausion, and attention is now being given to the cultivation of the plant (*Der Tropenflanzer*, 1909, **10.** 386). It grows in Peru at an elevation of from 700 to 2,500 metres above sea-level, and requires a deep, fairly rich soil. In forming a plantation the existing crop on the land is cut and the débris from this piled in heaps and burnt, the heat from the burning refuse serving to destroy insect pests in the soil. The plants are best raised from seeds sown in nurseries. Coca seed keeps badly, and it is advisable to use seed not more than eight days old for sowing. The seed bed should consist of good, well-worked soil, and the seeds should not be deeply buried, but merely lightly covered with a thin layer of soil. They should germinate in about a fortnight, and should reach a height of from 8 to 12 inches in about four or five months, when they are ready for transplanting. The soil in the proposed plantation should be well worked to a depth of about one foot, and the seedlings planted out at distances of about 40 inches from each other, *i.e.* 40 inches square should be allowed to each plant. The plantation requires little care except occasional weeding, but young plants in the nursery or the plantation require shading from strong sunshine and protection from frost on cold nights. Leaf collection should not begin till the plants are two years old, but to secure a return in the first two years, maize or manioc (cassava) may be taken as a catch crop between the rows of coca plants. In collecting the leaves, these should not be roughly torn from the branches, but should be broken off, or cut a little above the connection of the leaf

petiole with the branch. A well-grown plant should yield annually from 5 to 10 lb. of leaves, and should continue to yield for from ten to twenty years, provided it is grown in good soil and a suitable situation. The leaves should be slowly dried in a shady place, frequent turning being resorted to, to prevent sweating.

The present value of Peruvian coca leaves is about $5\frac{1}{2}d.$ to $6d.$ per lb., but the carefully grown and prepared Ceylon leaves fetch as much as 10*d.* to 1*s.* per lb., or more, at the present time. Since the natural supply of Peruvian leaves is failing to some extent, there would appear to be an opening for the moderate extension of coca-planting in Ceylon and the Federated Malay States, where the plant has been found to do well already. In forming plantations care should be taken to secure seed of the Peruvian variety, the leaves of which contain cocaine, and not that grown in Java, which furnishes leaves containing little or no cocaine, but only closely related alkaloids, which have to be converted into cocaine by a chemical process after extraction. The Java leaves, it should be noted, however, are richer in "total alkaloid" than the Peruvian sort.

Production of Cinchona Bark.—At the present time the production of cinchona bark is almost confined to Java, the exports from Ceylon, India, S. America, San Thomé and elsewhere, though of some importance, being almost negligible in comparison with the quantities shipped from the Dutch East Indian Island.

In spite of this practical monopoly of the cinchona industry there has been much dissatisfaction among planters in Java for many years on account of the low prices obtainable for bark, and various attempts have been made to restrict the output of bark and thereby force prices to a higher level. An agitation of this kind is at present proceeding in Java, which has for its object the reduction of the output by 25 per cent. and the raising of the price of bark to a minimum of six cents per kilo for each unit per cent. of quinine sulphate obtainable from it. It is stated that the proposed restriction in output is likely to find support not only among planters in Java but also among merchants dealing in cinchona bark in Europe, and possibly also among manufacturers of cinchona alkaloids in Europe and the United States. On the other hand, competent authorities are of opinion that the interests involved are too numerous and too much opposed in objective to permit of the restriction of output being carried into effect. The proposal is, however, one of some interest to the owners of cinchona plantations in Ceylon, India, and other British possessions, and also to the governments of such countries as India, Italy, Greece, and others which have undertaken the supply of quinine to their inhabitants as a preventive of malaria.

Wattle Barks from German East Africa.—In previous articles in this *Bulletin* (1908, 6. 86, 164), reference has been made to the formation of

plantations of wattles in German East Africa with a view to the production of timber for fuel and bark for tanning. According to a recent report two trial consignments, each of about one ton, of the barks of *Acacia mollissima* and *Acacia decurrens*, were sent from this German Protectorate to a firm in Hamburg for trial and valuation. On analysis the barks gave the following results:—

	Acacia mollissima bark.	*Acacia decurrens* bark.
	Per cent.	*Per cent.*
Moisture	12·0	11·0
Total soluble solids .	48·6	42·2
Non-tannins	8·5	9·3
Tannin	40·1	32·9

As regards tannin content, the barks were therefore not inferior to the better classes of Natal wattle barks, but both consignments had a dark red colour, due, it is supposed, to the method of drying adopted. This decreased their value to £8 per ton for *A. mollissima* bark, and £7 15*s.* per ton for *A. decurrens* bark, as against £8 10*s.* per ton c.i.f. Hamburg, for average Natal wattle bark. Attention is now being paid at the Agricultural Station in Amani, to ascertaining the cause of the dark colour and the possibility of preventing its formation, so that a better product may be placed on the market.

Cotton Growing in French Colonies.—Short accounts of the progress of cotton cultivation in the French Colonies have been given in this *Bulletin* (1904, **2**. 122; 1908, **6**. 288). During the year 1908 the industry made substantial progress in spite of some unexpected reverses. In Dahomey and in Senegal and Niger the season was exceptionally dry, whilst in Algeria the crop was considerably reduced by the attack of locusts. The total production of the Colonies exceeded that of 1907 by only about 7 tons, but there are no grounds for discouragement, since decided progress was made everywhere except in West Africa. The approximate quantities of ginned cotton produced in 1907 and 1908 are compared in the following table:—

	1907.	1908.
	lb.	lb.
Senegal, and Upper Senegal and Niger	88,620	40,240
Dahomey	201,630	130,170
Algeria	69,950	133,180
Guadeloupe	2,300	35,610
New Caledonia	—	11,020
Réunion	—	2,090
Madagascar and the Comoro Islands .	—	23,040
Somali Coast	—	1,100
Tahiti	—	2,200
Total	362,500	378,650

RECENT REPORTS FROM AGRICULTURAL AND TECHNICAL DEPARTMENTS IN THE COLONIES AND INDIA.

In this Section of the Bulletin a Summary is given of the Chief Contents of general interest, of Reports and other publications received at the Imperial Institute from Agricultural and Technical Departments, in the Colonies and India.

UGANDA PROTECTORATE.

Report on the Botanical, Forestry and Scientific Department, 1908–09; Colonial Reports Miscellaneous, No. 64.—The total number of plants distributed was 56,917; in addition, 230,000 Para rubber seedlings and 6,000 cocoa seedlings were imported during the year on behalf of planters and chiefs. Experiments in the cultivation of cocoa, rubber, tobacco, Sisal hemp, Mauritius hemp, coffee and wheat are in progress. A still for the preparation of lemongrass oil has been erected, and a small consignment of this oil has been shipped to London for sale. Special attention has been given during the year to the encouragement of beeswax production (see this *Bulletin*, p. 29). A successful agricultural exhibition was held during the year at Kampala. An attempt to acclimatise Angora goats has proved unsuccessful, but it is hoped to improve the native goat, and South African stock is being imported for that purpose. A large number of English breeds of fowl has been imported from East and South Africa with a view to improving the native breed of poultry. The progress of the Uganda cotton industry has been dealt with in a separate report (see this *Bulletin*, 1909, 7. 442). Separate articles on tobacco cultivation, entomology and cotton inspection by the respective experts on these subjects complete the report.

EAST AFRICA PROTECTORATE.

Agricultural Journal, 1909, 2. Part 3.—Wheat (a *résumé* of information on the milling properties of "Gluyas," "Rietta" and other wheats, so far grown in East Africa)—Discussion on Sisal planting in British East Africa (an account of the proceedings at a conference of Sisal planters held at Nairobi. A history of Sisal planting in British East Africa is given, and the various difficulties so far experienced are mentioned)—The fear of deterioration (deals with the breeding of sheep for wool production)—Extracts from a diary written during a journey down the Tana River—Notes on wool.

Annual Report of the Department of Agriculture, 1908–09.—Contains reports by the Director of Agriculture and by the Principal Officers of the several Divisions of the Department. It is pointed out that

maize is coming more and more into favour as a food-stuff with the natives, since it is more palatable than Sorghum, and matures more rapidly than the latter. Maize is also being grown by settlers, and seed of "late," "medium," and "early" varieties have been imported for trial at the experimental farms. Great attention is being given by the Department to the cultivation of beans for export, and a large number of varieties are being tried. Some of these are at present under examination at the Imperial Institute. There has been a marked development in wheat production, and very satisfactory results have been obtained. "Gluyas" has proved on the whole to be the variety best suited to the country, and large quantities of seed of this kind are being imported for trial. A milling plant has been erected at Nairobi and there is every prospect that the local demand for wheat will be met and that, eventually, a large export trade may be developed, especially with South Africa. Marked headway has also been made in coffee production, but it is pointed out that the crop is so uncertain that planters should not occupy themselves solely with it. An interesting wild coffee has been found in the Nandi forest, where it is estimated that about 8,000,000 wild coffee shrubs exist. Samples of this coffee are now under examination at the Imperial Institute.

Experiments with flax and cotton are in progress, but perhaps the most promising of the fibre industries is the cultivation of Sisal hemp, which is likely to occupy a prominent position, especially in the Coastal and lower Highland Districts. The fall in price of coarse textile fibres has checked the utilisation of the indigenous Sansevierias as sources of fibre. The principal difficulty in this and similar industries is the cost and scarcity of labour, and this question is being carefully considered by the Administration and the planters with a view to finding a satisfactory solution, either by the better organisation of indigenous labour or by importing labour.

Coco-nut palms, sesame and ground-nuts are all being planted more extensively.

The foregoing notes refer only to the more important crops, and in the sections relating to "Experimental Farms," "Naivasha Stock Farm," and in the reports by the Entomologist, Registrar of Brands, Inspector of Fencing, Chief Veterinary Officer, and the Chief of the Economic Plant Division, full details are given of the experimental and other work in progress.

TRANSVAAL.

Mines Department. Report of the Geological Survey, 1908.—The Director summarises the work done during the year. This is followed by descriptions of the geology of the various districts surveyed, viz. (1) the country north and north-west of Potgietersrust; (2) a portion of the Waterberg district west of Potgietersrust; (3) Hoekbergen in the Waterberg district; (4) the country east of Potgietersrust, and that between Zeerust and Zwartruggens; (5) a portion of the Bushveld

bordering the Crocodile River, and including the Rooiberg Tin-field, and (6) the south-western portion of the Marico district.

The report contains valuable results of a purely geological character, but perhaps the most important feature is the work undertaken in connection with the field-mapping. This has included a thorough examination of nearly all the known occurrences of cassiterite, which together make up the Waterberg tin-fields, the extensive mining operations in which promise very soon to assume the proportions of an important industry. A detailed description of all the mine workings and prospecting ventures visited, together with a full account of the geology of the area in which they occur, will be found in a special memoir issued by the Geological Survey, entitled *The Geology of the Waterberg Tin-fields* (see this *Bulletin*, 1909, 7. 416), but general descriptions of the tin-deposits are also given in the present report, in connection with the reports of the geologists upon those areas in which such occurrences have been examined.

In addition to the detailed examination of the tin-fields, the lead and zinc deposits of the Marico district have been investigated. These ores are reported to have been deposited along certain lines which follow the strike of the Dolomite, and are associated with its upper portion, not far from the base of the Pretoria series. With perhaps one exception, they may be considered as replacement deposits, the lead occurring as large irregular masses in manganiferous earth, which can be shown to have taken the place of the Dolomite.

The various reefs of the Malmani goldfield, which has been for some time in a practically abandoned condition, are described.

In the Pietersburg area the Marabastad goldfield was visited and surveyed. The greater portion of this area is occupied by the schist belt of the Mount Maré range, which is assigned to the Swaziland system. It contains several auriferous quartz-reefs, which sometimes occur parallel to the bedding-planes of the country rock, and sometimes cut across them. Alluvial gold has also been worked at several localities in the same district.

The report is illustrated by plates, sections, and coloured maps, the last mentioned including a revised map of the Transvaal colony, dated January 1909.

Dry-farming in America.—A report to the Transvaal Government by Mr. W. Macdonald, Dry-Land Agronomist to the Transvaal, on the present position of dry-farming in the United States. In the first chapter an account is given of the proceedings at the Third International Congress on Dry-farming, held at Cheyenne in 1908, at which papers on this subject were read by delegates from Russia, China, Australia, Canada, Brazil, and the Transvaal, though most of the communications were from the United States, where dry-farming has so far attained its highest development.

A *résumé* is then given of the important work accomplished by the United States Department of Agriculture in the investigation of the

conditions affecting the cultivation of semi-arid lands, and finally descriptions of some of the most successful dry-land farms of the Western States are supplied.

In two appendices a short but useful account of what dry-farming means, and lastly a description of dry-farming in Wyoming are given.

NATAL.

Report on the Mining Industry of Natal for the years 1907 *and* 1908.—This gives details with regard to various kinds of prospecting work which have been undertaken during the period referred to; and also numerous statistics connected with the regular mining operations carried on in the Colony. The output of coal continues to increase, being 1,669,774 tons (worth £737,169) in 1908, and 1,530,043 tons (worth £690,391) in 1907, as compared with 1,238,713 tons (worth £524,296) in 1906. The coal output is nearly double that of 1904, viz. 858,298 tons. Much attention has been given to prospecting and development for copper, gold and graphite. Flaky graphites occur in the Colony, but it remains to be proved whether these can be worked profitably.

Iron ore deposits were prospected near Alverstone station, 33½ miles from Durban on the main line. The following are the percentage compositions of two samples of these ores:—

	Silica.	Ferric oxide.	Alumina.	Titanium dioxide.	Phosphoric anhydride.	Sulphuric anhydride.	Water.
Assegai Kraal.	17·4	56·33	13·67	0·25	0·25	0·17	12·44
Sterk Spruit .	17·7	59·86	6·54	0·10	0·21	0·23	12·22

The ore carries only a low percentage of iron, but its proximity to the railway and port, and the ease with which it may be obtained from surface workings, are great advantages. Two syndicates have undertaken the work of testing the commercial possibilities of these and other Natal iron ore deposits, by smelting on a small scale. Sample shipments of manganese ore have been obtained from the Vryheid district. Mineral phosphates have been found in many localities and in considerable quantities. Numerous large tin-bearing pegmatite lodes have been found in the Umfuli Valley, in the Entonjaneni district of Zululand, but the proportion of tinstone in the best of the known lodes, taken as a whole, is too small to permit them to be worked at a profit. Wolfram has also been discovered at the same locality, but only in small quantities.

Agricultural Journal, 1909, **13**. No. 3. Contains, in addition to reprints and abstracts of articles from other journals, the Reports for July and August of the Division of Agriculture and Forestry. In this the results of sugar-cane experiments at the Winkel Spruit Farm are given, and of wheat and barley experiments at the Weenen Station. No. 4.—The seasoning and characters of Natal native timbers (a series

of notes on the methods adopted in felling and storing timber in Natal, with suggestions for improvements)—Consumption of maize (the results of a statistical inquiry as to the quantity of maize used in Natal; shows that this amounts to 337,650 muids)—Maize export (The total exports from Port Natal during the nine months ending September 30, 1909, amounted to 580,781 bags, of which 364,759 came from the Orange River Colony, 131,973 from Natal, and 84,049 from the Transvaal. Details as to the amounts of the various grades shipped are also given)—Division of Agriculture and Forestry (report for September).

CAPE OF GOOD HOPE.

Agricultural Journal, 1909, **35**. No. 4.—Agricultural Zoology for South African students (continued from the previous number)—Lucerne Tylenchus (gives a description with remedial measures against *Tylenchus dipsaci*, a nematoid worm well known in Europe as affecting various farm crops and which has recently appeared on lucerne in Cape Colony)—Experimental crops in Cape Colony (The Agricultural Department maintains a system of distributing seeds for experimental purposes to farmers throughout the Colony on condition that a report is furnished on the results obtained. In this article summaries of the results of trials conducted in this fashion with four grasses are given, viz. *Paspalum dilatatum*, "cocks-foot grass," "Italian rye grass" and "Devon evergreen rye grass")—Manurial experiments on cereals (gives the results of experiments carried out during 1907–09 at the Knysna Experiment station with oats, barley and rye. For each crop a series of different manures was used, and the resulting increases and the costs of the manure applied are tabulated. Generally the results indicate that phosphates are essential, that a further increase is obtained by addition of sodium nitrate or potassium sulphate, and that if an excess of nitrogenous manure is applied to barley the weight of straw is increased to the detriment of the grain)—Bechuanaland from the irrigation standpoint (continued from previous numbers)—The production of ostrich feathers (a series of resolutions submitted to a congress of ostrich farmers held in September. These deal mainly with methods of preventing the export of inferior feathers, and of limiting the output)—Almeria grapes and their cultivation (a *résumé* of information obtained from the British Vice-Consul at Cordova and from British Consular Reports)—East Coast fever (gives a *résumé* of the action taken to prevent the introduction of this disease from Natal and the Transvaal)—Experiments with ostriches, X. (deals with the production of "bars" in ostrich feathers). No. **5**.—Bechuanaland from the irrigation standpoint. Agricultural Union of Cape Colony (proceedings of the Twelfth Annual Congress, 1909)—Agricultural Zoology for South African students. The Mally fruit fly remedy (spraying with sweetened solution of lead arsenate is recommended)—The Codling Moth (a popular, explanatory article on this insect pest)—The Wine industry in South

Africa—Experiments with ostriches, XI. (gives a description of the Stellingen acclimatisation farm near Hamburg)—The "cotton stainer bug" (this insect has become formidable in the Transkei District, and in this connection descriptions of the habits of the insect and the means of destroying it are given)—Euphorbia latex as an "anti-corrosive" (the latex is recommended (1) as a preservative for timber against attack by white ants; (2) as an anti-corrosive paint for iron; and (3) as anti-fouling material for the bottoms of ships). No. 6.—The sale of fertilisers and farm foods (a series of notes on the new regulations governing the sale of these products)—Judging and valuation of ostrich feathers required for special purposes—Experiments with ostriches, XII. How weakness and density of flue are produced. Bechuanaland from the irrigation standpoint (continued).

SOUTH AFRICA.

South African Central Locust Bureau. Third Annual Report of the Committee of Control.—Describes the organisation of the Bureau, which is to be maintained for five years by *pro rata* contributions from the British South African Colonies. The present report deals with the conditions relative to migratory locusts in South Africa in 1908–09. Two species are known as pests in South Africa, viz. the "red-winged locust" and the "brown locust." The former gave comparatively little trouble in the season under review in the British territories, but was present in large swarms in Mozambique. The "brown locust" also gave less trouble than in former years, but in March 1909 this species hatched out in great numbers in the Kalahari desert, and about the middle of March great swarms were reported migrating southward over the Orange River Colony. These swarms have spread over about 125,000 square miles of territory in Cape Colony, and a visitation is expected there this spring, and energetic measures are being taken to combat it. The most important checks are the burning of grass, the spraying of a sweetened solution of sodium arsenite on vegetation, and the encouragement of birds such as storks, kestrels, kites, pheasants, etc., which prey on locusts.

The report contains short statements by officers in charge of locust destruction work in Cape Colony, Natal, Transvaal, Orange River Colony, Southern Rhodesia, Basutoland, Bechuanaland, Mozambique, and German South-West Africa during the year 1908–09.

MAURITIUS.

Station Agronomique, Bulletin No. 21.—Gives a general account of the cultivation of the ground-nut (*Arachis hypogea*), and of the so-called "Bambarra ground-nut" (*Voandzeia subterranea*), with analyses of all parts of both these plants. It is pointed out that the extended cultivation of the former in Mauritius, depends mainly on the possibility of expressing the oil from the kernels locally.

Annual Report on the Forests and Gardens Department, 1908.—Gives an account of the exploitation of major and minor forest produce during the year, and of the work done in the various forest nurseries, and of the condition of the several experimental plantations at the Botanical Gardens at Pamplemousses.

INDIA.

Agricultural Journal, 1909, 4. Part 4.—Lucerne or Alfalfa cultivation (a *résumé* of information with illustrations)—The Saidapeth Agricultural College and Farm (gives a short historical account of this institution and the work done there since its inception over forty years ago)—The extension of cultivation of fibre plants in India (a report drawn up by a special committee for the information of the Board of Agriculture. It is concluded that the cultivation of jute, sann hemp and *Hibiscus cannabinus* fibres might be extended with advantage in the immediate future, and that later on a portion of the linseed already grown in India for the sake of the seed might be used also for the production of fibre. It is also thought that Agave cultivation might be increased in certain parts of Assam. Stress is laid on so arranging the rotation of food and fibre crops that the increase of the latter should not be at the expense of the former)—Lucerne dodder (records the occurrence of *Cuscuta chinensis* in the North Thana district of Bombay. It is pointed out that every trace of dodder plant should be destroyed in hedges surrounding the fields, and that a careful search should be made for dodder seed in lucerne seed intended for sowing)—Cultivation of tea in the Kachin Hill tracts of Katha, Burma—Betel leaf at Chikkodi, Belgaum district—Note on taking soil samples—Bat guano in Burma (gives the results of analyses)—The Gassibiah or scraper for levelling land (describes and illustrates the scraper in use on the Mirpurkhas farm).

Department of Agriculture, Eastern Bengal and Assam. Bulletin No. 22. *Poultry Industry*.—There is a large poultry industry in certain districts of the Chittagong Division of Eastern Bengal, and considerable quantities of ducks, fowls and eggs are exported thence to Burma. Inquiries have been made in order to ascertain the possibility of developing this industry and of improving the breeds of poultry. The present report gives an account of the principal features of the industry in the Noakhali and Chittagong districts, together with some recommendations with regard to means for facilitating export. A brief account is also given of the measures approved by Government for the improvement of poultry in Eastern Bengal and Assam.

Report on the Operations of the Department of Agriculture, Madras, 1908–09.—The introduction of Mauritius sugar-canes into the Godavari and South Arcot districts has resulted in the rapid replacement of the inferior local varieties; the area under the Mauritius cane in South Arcot has increased since the year 1907–08 from 60 to 247 acres, whilst only 130 acres are now devoted to the old local kind. Several new varieties of cane have been tested on the Samalkota farm. With regard

to cotton cultivation, it has been decided to relinquish the attempt to grow superior varieties imported from other provinces of India, and to endeavour to improve the local forms by selection. Experiments have been carried out on the cultivation and manuring of rice. The practice of planting rice seedlings singly instead of in groups is making good progress among the ryots. Attempts to grow Bengal jute at Samalkota have shown that this fibre cannot be introduced successfully into the Godavari delta. The *Agave* plantation at Hindupur was extended, and gave a yield equivalent to 430 lb. of dry fibre per acre. Ground-nut cultivation is now well established in Malabar, and an attempt to introduce it into South Canara promises to be successful.

Bulletin No. 61. *Improvements in Paddy Cultivation on the Home Farm at Sivagiri, Tinnevelly District.*—A study of rice cultivation with a view to the introduction of improvements has been carried out at Sivagiri during the last eight years, and considerable success has been achieved. The chief lines of improvement are the replacement of the ordinary wooden plough by an iron plough, the application of farmyard and other manures, the practice of green manuring with sunn hemp (*Crotalaria juncea*) or other leguminous crops, and judicious irrigation. It has been found that the amount of seed used for sowing can be greatly reduced without diminishing the yield, by transplanting single seedlings instead of groups containing from two to twenty. Several new varieties of rice have been introduced from Northern India and other places. Seed is specially selected each year from the most promising of the introduced varieties as well as from the local varieties, and is used for sowing on the Farm in the following year. Some of the selected seed is also available for sale to ryots. From a consideration of the value of the crop and the cost of its production at the Home Farm, it is shown that rice-growing can be made a very profitable industry.

Central Agricultural Committee, Madras. Bulletin No. 6. *Single Planting in Paddy.*—Ryots are strongly advised to plant rice with single seedlings instead of with bunches of seedlings. The advantages to be gained by this practice are pointed out, and information is supplied with reference to the cultural operations involved.

Department of Agriculture, Bombay. Annual Report of the Mirpurkhas Agricultural Station (Thar and Parkar District, Sind), 1908–09.—A series of rotation experiments is being carried out with berseem, cotton, wheat, and other crops. It is considered that the adoption of a general system of rotation would be of great benefit to the development of cotton cultivation in Sind. Two varieties of Egyptian cotton, viz. Mitafifi and Abassi, were grown during the year, and the products obtained were of good quality although the yields were poor owing to unfavourable meteorological conditions. Experiments were also made with American and indigenous varieties of cotton, and with wheat, oats, various pulses, jute, sunn hemp, berseem and other crops.

Annual Report of the Daulatpur Reclamation Station (Thar and

Parkar District, Sind), 1908–09.—This station was established in 1908 with the object (1) of demonstrating a practical method of bringing alkali or "kalar" land into cultivation; (2) of showing the advantages to be derived from the adoption of rotations and increasing the standard of cultivation; and (3) of encouraging the planting of Egyptian cotton. The work accomplished hitherto has resulted in the reclamation of 200 acres of land, of which 100 acres have been let for cotton-growing and 100 acres for cereals. It has been proved that berseem (*Trifolium alexandrium*), on which the fertility of Egypt so largely depends, grows very well in Sind in areas provided with an available supply of water.

Report on the Agricultural Stations, Central Provinces and Berar 1908-09.—A record of the work carried out at the Agricultural Stations at Nagpur, Hoshangabad, Raipur, and Akola, and at the Telinkheri Seed Farm. Numerous manurial and rotation experiments have been conducted with various crops, including cotton, rice, maize, wheat, sorghum, sunn hemp, safflower, sesame, gram, "tur" (*Cajanus indicus*) and jute. Experiments on the selection of cotton have been continued, and a quantity of the "Buri" variety has been grown for seed. A small area was planted with soy bean, and a fair yield was obtained. Trials were made with a number of new agricultural implements. Experiments which have been carried out with jute at the Telinkheri Seed Farm during the last three years have led to the following conclusions. In order to grow jute successfully it is necessary that (1) the ground should be well tilled; (2) the seed should be sown in dry soil and lightly covered to a depth of ½ inch to 1 inch, the plot having been first furrowed by means of a harrow with teeth about 6 inches apart; (3) when the plants are about 4 inches high they should be thinned out, leaving a distance of about 6 inches between them. If the retting is done in October, it requires about 25 days, but if left until the cold weather has begun, it takes six weeks. If jute and sunn hemp are sown at the same time and under the same conditions, the former gives the larger crop of fibre. In an appendix to the Report a statement is made of the results of experiments carried out with a number of varieties of wheat, particularly with reference to hybridisation and selection, and the irrigation of the crop.

Report of the Department of Agriculture, Punjab, 1908–09.—The chief work of the year consisted in making the necessary preparations for the opening of the Agricultural College, in carrying out experiments with new and improved varieties of crops, and in introducing agricultural machinery. Important results have been obtained with reference to the milling and baking qualities of Punjab wheats. These show that the red wheats, which are best adapted for cultivation in the Province, are superior in both qualities to the soft white wheats which have hitherto been the chief kinds exported. Attempts are being made to revive the silk industry, and experiments have been made at Gurdaspur, Chhanga Manga and Lyallpur with satisfactory results. Trials have been made with the Hadi process of sugar manufacture, and have indicated that

this method is not suitable for adoption in the Punjab. Considerable attention has been given to bee-keeping and poultry-farming. The report on the work of the Lyallpur Agricultural Station has been published separately (*see below.*)

Annual Report of the Lyallpur Agricultural Station, 1908–09.—The work carried out at this station included cultural and manurial experiments, trials of new agricultural implements, and an experiment in sericiculture. About 1,000 varieties and selections of cotton have been grown, and schemes have been devised for arranging them systematically for recording the characteristics of the plants, and for judging the relative values of the selections. In view of the results already obtained, about two-thirds of the cottons have been discarded. Two types of American cotton and one indigenous variety ("Lyallpur desi") have given promising results, and it has been decided to test these cottons on a large scale before the seed is distributed to the zamindars. A large number of experiments have been carried out with wheat. Several varieties of Australian wheat were grown, but did not give such good yields as the indigenous varieties. About two hundred selections of indigenous wheats were grown separately, and it was found that the beardless common wheats with red glumes gave the largest crops. Four plots were sown with jute, but the crop was seriously injured by the semi-looper caterpillar (*Cosmophila sabulifera*). It was found that the jute plants required watering about once a fortnight. The retting experiments indicated that the ordinary zamindari pit gives results equal to those obtained by the use of cemented tanks. Several other crops were grown, including barley, oats, gram and cassava. The sericicultural experiment was undertaken in order to ascertain whether the silkworm (*Bombyx mori*) could be reared successfully in the Punjab plains, a supply of eggs being obtained from France for the purpose. The eggs nearly all hatched and a satisfactory yield of silk was obtained. This result was regarded as very favourable, since it had been generally assumed that silkworms would not thrive in the plains.

Department of Agriculture, Mysore State. Report of the Agricultural Chemist, 1907–08.—An account is given of experiments on the cultivation of "ragi" (*Eleusine coracana*), including the standardisation of the plots, the determination of the best time for sowing, and the question of manuring, particularly of green manuring by means of leguminous crops. Manurial experiments have also been carried out in connection with rice cultivation. An investigation of the factors on which the quality of coffee depends has led to the conclusion that the specific gravity of the bean is fairly reliable, and is the best numerical index of the quality at present available. Some trials with sugar-cane were rendered valueless on account of the plants being attacked by disease, which probably arose from an insufficient supply of water. Pot culture experiments and trials of new farm machinery are also recorded.

Report on Investigations of Jute Fibre in relation to Heart Damage of Baled Jute.—An account of investigations carried out by Messrs. Cross

and Bevan, in the United Kingdom, with the object of elucidating the cause of heart damage in bales of jute. The expression "heart damage" signifies the decay of the fibre which sometimes takes place in the centre of commercial bales. This decay causes the fibre to become exceedingly weak and ultimately produces complete disintegration of the material. It has been found that the damage is due to profound chemical changes in the fibre substance, resulting from the action of enzymes produced by the growth of bacterial organisms under anaerobic conditions. The results of the experiments also show that the decay does not occur in the presence of formaldehyde, since this compound acts as an antiseptic preventing the growth of micro-organisms.

Annual Report of the Royal Botanic Garden and other Gardens in Calcutta, and of the Lloyd Botanic Garden, Darjeeling, 1908–09.—A record of the work carried out at these Gardens during the year under review. Two new species of rubber trees, *Manihot dichotoma*, Ule, and *M. piauhyensis*, Ule, natives of North-East Brazil, have been introduced into the Royal Botanic Garden, the seed having been received from the Royal Gardens, Kew.

Progress Report of the Imperial Forest Research Institute, 1908–09.—A record of the administration, work and expenditure, of the Imperial Forest Research Institute. A study has been made of the coppicing and reproduction of teak, and it has been found that, contrary to the general opinion, coppicing towards the close of the period of vegetative activity is not injurious. Forest grasses have also been studied with special reference to the effects of fire on them. An investigation of the various species of *Grewia* is in progress, with a view to their accurate determination and classification. Numerous economic inquiries have been conducted, of which the most important was concerned with the match industry. Efforts have been made to draw attention to certain timbers which are not well known, although meriting recognition, and experiments have been carried out with the object of ascertaining the behaviour of a number of woods during the process of seasoning. The principal chemical investigations were concerned with the manufacture of mangrove extract, the extraction of oil from oil-seeds, the manufacture of shellac, the isolation of Ngai camphor from *Blumea balsamifera*, and the distillation of turpentine. The zoological work dealt chiefly with the insect pests attacking "sal" (*Shorea robusta*) and conifers. In an appendix to the report, a complete list is given of the various publications issued by the Institute since its formation.

Forest Records, 1909, 1. Part 4.—A chemical investigation of the constituents of Burmese varnish [*Melanorrhoea usitata* sap.]. (A systematic chemical examination of this material shows that it is practically identical in composition with the better known Japanese lacquer (this *Bulletin*, p. 34), and that the conditions needed for its drying are the same. A number of recommendations for improvement in the collection and preparation of the varnish are made)—The selection system in Indian forests as exemplified in working plans based

on this system, with a short description of some continental methods. Vol. 2. Part I. On some insect pests of the Himalayan Oak (*Quercus dilatata* and *Q. incana*).

Forest Pamphlet, No. 6. *Sylvicultural Series*, No. 2. *Forest Reservation in Burma in the Interests of an Endangered Water-supply.*—In 1904–05 it was proposed to establish forest reserves in the Natmauk township, viz. the Pingadaw, Thamyagon, Lower Yin, and Myinde Reserves, comprising an area of 330 square miles, in order to conserve the water-supply of various large streams, which furnish the means of irrigation. A full account is given of the nature of this land and its forestry. The soil is, as a rule, very poor, and the greater part of the forest consists merely of scrub. The land will not furnish a crop unless it is allowed to lie fallow for four out of every five or six years, and consequently the villagers go from place to place cutting the forest and cultivating small patches, and even then are unable to obtain more than a scanty livelihood. For this reason, the population of the township was opposed to the proposed reservation, feeling that the Government would be confiscating their land and neglecting their interests. Reservation was thus rendered very difficult, and only a small part of the proposed area could be actually reserved. In some cases, large areas had to be left out of the scheme, since they contained numerous small cultivated patches which it was impossible to buy or demarcate out. A statement is given showing the area of each reserve as proposed and as settled, and the amount to be paid in compensation. It was found necessary to grant grazing rights over large areas bordering on villages. In conclusion, suggestions are made as to measures which could be taken to ensure the protection of the water-supply, but these would involve the reservation of forty-two square miles, which contain twenty-one villages, and would, moreover, be extremely expensive. It is suggested that the people who would be turned out of these villages could be taken to the new land being opened up along canals in Upper Burma, although they would doubtless strongly object to such procedure.

No. 7 (see this *Bulletin*, 1909, 7. p. 330).

No. 8. *Working-Plan Series*, No. 2. *The Collection of Statistical Data Relating to the Principal Indian Species.*—One of the most important functions of the Imperial Forest Research Institute is the collection of statistics relating to the development of the principal trees suitable for timber. In order to establish a uniform procedure for the whole of India, so that it may be possible to compare and collate the data obtained by different investigators, a series of experiments and the rules to be observed in carrying them out, have been drawn up, and are presented in the pamphlet. It is hoped that after the details have been discussed by the Conservators, the rules will become a recognised standard. In an appendix a list is given of the problems relating to the collection of statistical data at present under investigation in each Province of British India outside the Madras and Bombay Presidencies, together with a table of the existing experimental plots.

No. 10. *Forest Economy Series*, No. 3. *Burmese Leza Wood* (Lagerstroemia tomentosa, Presl.).—The "leza" tree (*Lagerstroemia tomentosa*, Presl.) occurs widely in Burma in the more humid forests of the low-lying plains. A description is given of the tree, the wood and its properties, the system of working, and the probable annual yield of timber obtainable. The rates of Government duty, and the approximate prices of the timber in various localities, are tabulated. The wood is useful for furniture manufacture and for building purposes, and is at present being tested as to its suitability for railway sleepers. It is also suitable for box-making, and has been found satisfactory for the manufacture of matches.

No. 11. *Forest Economy Series*, No. 4. *Carallia Wood* (Carallia integerrima, DC.).—*Carallia integerrima* is found in moist or evergreen forests in many parts of India, but is nowhere very abundant. An account is given of its distribution, habitat and characters, and the system of working it, together with a description of the wood and its properties and uses. The duty rates and approximate prices of the timber in various localities are tabulated. The wood is used for building, and for the manufacture of furniture and agricultural implements, and has been found suitable for the backs of brushes; it would also be useful for picture-frames and other ornamental work if cut in a radial direction so as to exhibit the silver grain. The roots and bark of the tree and the dried pulp of the fruit are used medicinally in certain parts of India, whilst in Bombay an oil is extracted from the seeds and used as a "ghi" substitute, and also to a small extent as an illuminant.

Annual Progress Report on Forest Administration of the Lower Provinces of Bengal, 1907–08.—At the close of the year under report, the total area of reserved forests amounted to 4,240 square miles, and that of protected forests to 3,392 square miles. It has been found that rubber trees (*Ficus elastica*) can be propagated in suitable areas at or near the bottom of the Tista Valley, at an elevation of 800–2000 feet, and that they grow remarkably well in such localities. At higher elevations, 2000–4000 feet, the results are not so satisfactory, but it is expected that greater success will be achieved when more experience has been gained. The total output of timber during the year was 5,179,112 cubic feet, as compared with 4,917,876 cubic feet in 1906–07; whilst that of fuel was 30,843,361 cubic feet, as compared with 29,698,670 cubic feet in 1906–07.

Annual Administration Report of the Forest Department of the Madras Presidency, 1907–08.—The total forest area at the close of the year amounted to 19,607 square miles, consisting of 18,549 square miles of reserved forests and 1,058 square miles of reserved lands. Experiments were made on the propagation and cultivation of a large number of trees, but promising results were obtained in only a few cases. In the Northern Circle, success was achieved at Ganjam with Ceara rubber, teak and *Pterocarpus Marsupium*. In the Central Circle, encouraging results were obtained with "divi-divi" (*Caesalpinia coriaria*)

in Nellore and North Arcot. In the Southern Circle, seedlings of camphor wood were planted in the Nilgiris, and grew satisfactorily; favourable results were also obtained in South Canara with *Swietenia Mahogani* and *Hevea brasiliensis*. The output of timber during the year amounted to 3,717,618 cubic feet, and that of fuel to 22,637,072 cubic feet, as compared with 2,617,131 cubic feet of timber and 21,440,557 cubic feet of fuel in 1906–07. Bamboos were collected to the number of 44,657,836, as compared with 43,713,964 in 1906–07.

Annual Progress Report of Forest Administration in the Western and Eastern Circles of the United Provinces, 1908–09.—The total forest area on the 30th June, 1909, amounted to 8,477,476 acres, or about 13,246 square miles, consisting of 1,286,524 acres in the Western Circle, 1,386,968 acres in the Eastern Circle, and 5,803,984 acres of District Protected Forests. Successful experiments have been made in the Naini Tal Division with *Acacia decurrens* and *Cryptomeria japonica*. Experimental cultivation of lac has been continued, but the results are by no means encouraging. The "chir" trees (*Pinus longifolia*) which were referred to in the Report for 1907–08 (see this *Bulletin*, 1909, **7**. 424) as having been tapped by diagonal channels have nearly all died, and the method is therefore unconditionally condemned. In the turpentine and colophony industry of the Naini Tal and Jaunsar Division, 189,875 trees were tapped and yielded 11,406 cwts. of crude oleo-resin, equivalent to about 7¾ lb. per tree. The total output of timber amounted to 5,860,042 cubic feet, of which the Western Circle contributed 2,390,902 cubic feet, the Eastern Circle 2,150,430 cubic feet, and the District Protected Forest 1,318,710 cubic feet. The total quantity of fuel collected was 10,208,130 cubic feet, of which 5,065,791 cubic feet were obtained from the Western Circle, 5,064,511 cubic feet from the Eastern Circle, and 77,828 cubic feet from the District Protected Forests.

Annual Report on the Forest Administration in Ajmer-Merwara, 1907–08.—The forest area comprises 90,679 acres of reserved, 115 acres of protected, and 3,471 acres of unclassed forest. The total output of timber during the year amounted to 8,295 cubic feet, and that of fuel to 630,831 cubic feet. Tapping experiments have been carried out with a view to increasing the yield of gum from *Odina Wodier* trees, but the results are not very promising. Some observations have been made with regard to the propagation of the lac insect, and investigations on this subject are still in progress.

Records of the Geological Survey, 1909, **38**. Part **1**.—Contains (1) General Report on the Geological Survey of India for the year 1908. Among the economic subjects dealt with are the following:—The manufacture of alum from pyritiferous bituminous shale in the Mianwali District, Punjab—Occurrence of chromite in serpentine at the Suru pass on the road from Chaibasa to Sonua, Singbhum, Bengal—Copper ore in Singbhum (this is generally of low grade, but may pay to work in some localities)—Iron ore in schistose magnesian rocks in Chota Nagpur

—New deposits of manganese near Chaibasa and Goilkora in Singbhum —Evidence has been obtained that the manganese ore of the Central Provinces is of "Archaean" age, which favours the probability of its not being confined to depths where the action of surface water may have taken place—Manganese deposits have also been opened up during the year in the Gangpur State in Bengal—Considerable attention was given to the Burmah Oil Fields, and the Director of the Survey presided over a Committee appointed to investigate the present conditions of exploiting the Twingôn and Bémé Reserves in the Yenangyaung Oil Field, to examine the dangers arising from flooding, fire, and wasteful methods of working, and an abstract is given of the results of its deliberations. Work was carried on during the year in the Mergui Archipelago, especially in connection with tin ore; in Balūchistān, where beds of Siwalik age were examined; in Central India and Rajputana. Along the western margin of the Deccan Trap the Aravalli and "Delhi" series were investigated, and in Northern Indore the "Lower Vindhyan" (Suket) shales and "Kaimur" quartzite. Obscure traces of organisms were found in shales in the "Delhi" beds, and in the "Lower Vindhyan" shales small concentrically wrinkled discs of carbonised chitinous substance, which may represent the genus *Obolella* or *Chuaria circularis* of the præ-Cambrian of Arizona, or possibly the operculum of *Hyolithellus*.

(2) The Mineral production of India during 1908. The total value increased from about £7,079,708 to £7,823,745. Coal increased by three quarters of a million sterling, and gold, petroleum, salt, saltpetre, jadestone, graphite, and magnesite in a minor degree; while the output of manganese ore, mica, rubies (with sapphires and spinel), tin, iron ore, and chromite showed decreases. A full list is given of the mineral concessions granted during the year.

Part 2.—Contains the following articles. On the occurrence of *Ostrea latimarginata*, a characteristic Gaj species, in the "Yenangyaung" stage of Burma. [On the evidence of this fossil it is recommended that the term "Yenangyaung" be discarded, and Newbold's original classification be adopted. The Lower "Yenangyaung" therefore becomes the Upper Prome (= Gāj of the West), and the Upper Yenangyaung, the Kama clay (= Hinglāj of Mekran Balūchistān.) The petroliferous sandstones appear to be intercalations in the Kama clay. The beds with *O. latimarginata* (and the Lower Hinglāj) are of Burdigalian (lower Miocene) age]—China clay and fireclay deposits in the Rajmahal Hills. (China clay occurs (*a*) in fundamental gneisses and schists, (*b*) disseminated or interbedded in the white Damuda sandstone. The material disseminated in the sandstone has been successfully worked, and yields china and porcelain of excellent quality. The fireclay occurs in beds in the Damuda rocks. In many localities it is quite infusible, and its texture is as fine and uniform as the best Stourbridge clay. Coarser material is found which would make good firebricks.)—The occurrence of coal at Gilhurria in the Rajmahal Hills

—Note on a Pegu Inlier at Ondwe, Magwe District, Upper Burma (an experimental boring for oil is suggested)—The origin of the salt deposits of Rajputana (evidence is adduced that salt is blown in a finely divided state by the south-west monsoon winds from the Arabian Sea, and more especially the Rann of Cutch across the desert to the Sambhar Lake, where it is now worked)—Miscellaneous notes.

Part **3**.—Report on the Geology of Sarawan, Jhalawan, Mekran and the State of Las Bela, considered principally from the point of view of Economic Development. (The western portion of the area is formed of the shales and sandstones of the Kojak or Mekran beds corresponding to the Oligocene "flysch" of Europe: the eastern, consisting mainly of limestones, ranges in age from Carboniferous or Permia to the base of the Pliocene. The economic products include coal, sulphur, salt, aluminium sulphate, copper, lead, antimony, magnesite and serpentine, the last-mentioned being used for ornamental purposes. Petroleum shows also occur, and boring is recommended.)—Note on a hippurite-bearing limestone in Seistan and on the Geology of the adjoining region. (The rocks include Cretaceous limestone; Siwalik and Pleistocene clays, sands and conglomerates; loess and recent deposits. The aeolian denudation is very extensive, but the principal depressions are believed to be due to tectonic causes.)—On Fusulinidae from Afghanistan. Miscellaneous notes: Oil at Jaba, Mianwali District, Punjab.

Report on Sanitary Measures in India in 1907–08, Vol. XLI.—This report deals fully with the health of the European and native troops, of prisoners in the jails, and of the general population; it also gives particulars with regard to vaccination, medical institutions (including hospitals, dispensaries and medical schools), lunatic asylums and sanitation.

Indian Trade Journal, 1909, **15**. No. 187.—Indian tobacco trade (points out that the bulk of the tobacco grown in India is unsuitable for export, and mentions that a European company has commenced the cultivation of cigarette tobacco in Bengal, and has equipped a cigarette factory)—Agricultural implements and machinery for the Punjab (gives short descriptions of the requirements of the Punjab agriculturist in agricultural machinery, such as ploughs, harrows, etc., for the guidance of manufacturers). No. **189**.—Indian Soy beans (gives analyses of fourteen samples of soy bean grown from Japanese seed at the Manjri Experimental Farm, showing that these contained from 16·8 to 22·4 per cent. of oil. Compare this *Bulletin*, p. 40).

No. **190**.—Weevil and dry wheat (a series of experiments by the Imperial Entomologist has shown that in wheat containing less than 8 per cent. of moisture, weevils do not breed, and that consequently freshly threshed wheat may be rendered immune to attack by weevil if it is exposed to the sun until its moisture content is reduced to about 7 per cent.: it should then be stored in such a way that it cannot absorb moisture). Imperial Institute Research Work (a *résumé* of

work done for India in 1907–08). No. **191.**—Contains (as a supplement) a detailed report on the Indo-Chinese-Turkestan trade *viâ* Ladakh. No. **193.**—Contains (as a supplement) a report on the trade of Siestan and Kan in 1908–09, and a short article on the use of cow-dung as fuel, deprecating the practice on account of the loss of manure involved. No. **194.**—Central Sugar Factory System (a short report on this system as worked in Java, Fiji, etc.)—Effect of jute cultivation on food supplies (discusses the effect of extension of jute cultivation on the production of rice and other crops in Eastern Bengal and Assam). No. **195.**—Moisture in copra—British grown cotton—Cement from slag (a note on the utilisation of blast furnace slag for the manufacture of cement). No. **196.**—Moisture in copra (continued). No. **197.**—Rust-preventing paints for metal structures—A new method of lacquering.

CEYLON.

Circulars and Agricultural Journal of the Royal Botanic Gardens, 1909, **4.** No. 22.—The stem-bleeding disease of the coco-nut. (Notes and reports on various aspects of this disease have been published already from time to time in Ceylon, and some of these have been referred to in this *Bulletin* (1908, **6.** 205; 1909, **7.** 109, 395). The present publication by the Government Mycologist gives a complete account of the subject since it first began to assume importance in Ceylon in 1906. A full statement is given of the history of the disease in Ceylon so far as this is known, its distribution in the island, the effect of the disease, its influence on the crops, methods of infection, treatment, etc. Incidentally a great deal of useful information on obscure points connected with the cultivation and manuring of the coco-nut palm is published, and there is an excellent discussion as to the value of salt as manure for this tree. The remedial treatment suggested for the disease is the cutting out and burning of all infected tissue, the wound being sterilised and then tarred. Spraying with Bordeaux mixture is recommended as a preventive of infection.)

Tropical Agriculturist, 1909, **33.** No. 5.—*Manihot dichotoma.* (Three one-acre plots of this rubber tree have been planted out at the Peradeniya Experiment Station. One of these is now two years old, and the average girth of the trees, at three feet from the ground, is nine inches. The twelve largest trees were tapped for ten days and yielded a total of 2·6 ounces of dry rubber. The trees vary a good deal in vegetative character and also in yield of latex. It has been found that this species can be propagated successfully by cuttings, and attempts are being made to select by this means trees giving a large yield of latex. The chief defect so far noticed in this rubber tree is its brittleness, the tops being very liable to damage by wind.)—The Litchi or Litchee fruit (a short description of the plant yielding this fruit is given with an illustration) —Miscellanea, chiefly pathological (*Corticium javanicum* has been found on coffee in Ceylon, in addition to the plants already enumerated (this

Bulletin, 1909, **7.** 338), and on Crotalaria in Southern India)—Entomological notes (The slug affecting Hevea rubber has now been identified as *Mariaella dussumieri*.)—Literature of economic botany and agriculture (this section contains entries relating to cotton)—Ceylon Agricultural Society (Progress Report 46).

No. **6.**—Miscellanea, chiefly pathological (describes (1) *Bacillus solanacearum* attacking Ceylon tomatoes, grown from seed imported from the United Kingdom, the removal and burning of diseased plants is recommended; further, the infected ground should not be used for Solanaceous plants, such as potatoes and tobacco, for the next two years, and (2) *Poria hypolateritia*, a root disease affecting tea, *Croton lacciferum* and other plants. It is pointed out that Grevillea stumps form a common starting point for the commonest of tea root diseases, viz. *Ustulina zonata*, and recommends that stumps both of Grevillea and Albizzia trees should be uprooted, where practicable, in tea gardens). Literature of economic botany and agriculture (this portion gives references to literature on cowpeas, Crotalaria, Croton, drugs, dyes, Elaeis, Eucalyptus, etc.).

STRAITS SETTLEMENTS AND FEDERATED MALAY STATES.

Agricultural Bulletin, 1909, **8.** No. 11.—Peat Soils (continued from the previous number, see this *Bulletin*, 1909, **7.** 427). The work of the Imperial Institute—Black Hevea fungus—Growth of Maniçoba rubber trees in the Malay Peninsula. No. **12.**—Brazil nuts (gives a short account of the tree (*Bertholletia excelsa*) yielding these nuts, and describes two of the trees raised in the Botanic Gardens from plants received from Kew in 1881)—An improved process for coagulating the latex of *Dyera costulata* (latex collected from trees of this species in the Botanic Gardens was coagulated with "purub," yielding a clear, white, hard, odourless product, which was reported on by experts in Vienna as being much superior to commercial "pontianac")—Black fungus of Hevea (this has been examined at Kew and found to be a new species of *Diplodia*, which it is proposed to name *D. rapax*).

Bulletins of the Department of Agriculture, Federated Malay States. No. **1.**—Notes on Termes Gestroi and other species of termites found on the rubber estates in the Federated Malay States. No. **2.**—Root diseases of *Hevea brasiliensis.* No. **3.**—Observations on Termes Gestroi as affecting the Para rubber tree, and methods to be employed against its ravages. No. **4.**—A lepidopterous pest of coco-nuts (*Brachartona catoxantha*, Hamps). No. **5.**—The extermination of rats in rice fields. No. **6.**—A preliminary note on a branch and stem disease of *Hevea brasiliensis.*

WESTERN AUSTRALIA.

Geological Survey Bulletin, 1909, No. **37.** *The Geological features of the country lying along the Route of the Proposed Transcontinental*

Railway in Western Australia (deals with the country from a few miles east of Kalgoorlie to the boundary with South Australia. There is little vegetation, and the old river valleys, now salt lakes, are being filled with drift sand. In the west are greenstones which have been prospected already. To the eastward granite, often more or less gneissose occurs. In some cases it contains tourmaline, but tinstone has not been found. Further east the country is formed of tertiary limestone).

SOUTH AUSTRALIA.

Journal of the Department of Agriculture, 1909, **13**. No. 3.—Report on the amount of spirits that may be extracted from a ton of raisins. In two series of experiments it was found that a ton of second grade raisins will yield 133–138 gallons of proof spirit, whilst from a similar quantity of first grade raisins from 147–155 gallons may be obtained—Notes on Kangaroo Island—Trials of stone-gathering machines—Analyses of arsenate of lead (gives analyses of a number of different brands of lead arsenate sold in South Australia for spraying purposes. No. **4**.—Destruction of locusts—South Australian produce in London—Irish blight.

Government Geologist's Reports on the recent mineral discoveries and boring operations in the Northern Territory—(Records discoveries of copper, lead, tungsten, tin, monazite (in a quartz vein), gold, bismuth, and tantalum, in Pine Creek district and adjoining area. Details are given of borings for coal and gold).

QUEENSLAND.

Agricultural Journal, 1909, **23**. Part. 4.—Wheat growing—Cheese-making—Contributions to the flora of Queensland and British New Guinea—Analyses of Queensland cheese. Part **5**.—Wheat rust—Stock ensilage—Green manuring—Experiments with cotton varieties at the Queensland Agricultural College—Contributions to the flora of Queensland and British New Guinea—Destruction of prickly pear with arsenical spray. Part **6**.—Contains contributions to the flora of Queensland (continued from previous numbers)—Insecticides and fungicides (gives analyses of a number of commercial preparation of this type with remarks on their value)—Fermentation of cigar-leaf tobacco.

Pearl-Shell and Bêche-de-Mer.—Report of the Royal Commission.—The Royal Commission was appointed to inquire into the best means of securing the following objects: (1) the working of the pearl-oyster beds of Queensland in such a manner as to avoid depletion and to make the industry regular and permanent, (2) the cultivation of pearl-oysters, and the probabilities of commercial success in that direction, and (3) the possibility of utilising white labour in these industries with a view to the gradual replacement of native divers. Summarising the results of their inquiries the Royal Commission finds (1) that the pearl-shell and bêche-de-mer fisheries are suffering from severe depression resulting

mainly from depletion of natural supplies, (2) that it is possible to cultivate the pearl-oyster on a commercial scale, and (3) that native divers may be gradually replaced by white divers. As regards the means for arresting depletion of beds the following recommendations among others are made. That no further fishing vessels be licensed until investigation has proved that the supplies of pearl-oysters have increased. That defined areas of the pearl-shell fishery be closed for a period of years, or alternately that all grounds, with the exception of the old ground, be closed for a prescribed period each year, and that except for special purposes it shall not be lawful to raise, open or remove any shell under six inches, nacre measurement. With a view to encouraging the cultivation of pearl-oysters it is recommended that a marine biologist be appointed, and that a well-equipped laboratory be established. It is also suggested that divers' licences be granted to white men and that the employment of native divers shall cease within five years of the establishment of a school of marine biology and a school for white divers. In order to protect owners of pearls it is suggested that special legislation be enacted somewhat on the lines of the Diamond Trade Ordinance of 1903 (Transvaal). It is also recommended that the bêche-de-mer fishery be closed for a period of two years, or longer if necessary, and that during such period of closure the export of bêche-de-mer from all Queensland ports be prohibited.

Government Mining Journal, 1909.—MAY.—Notes on some of the reefs of the Charters Towers Goldfield. (The greater part of the ground is occupied by a hornblende granite, which passes into a quartz diorite. It is traversed by basic dykes and auriferous quartz reefs.)—A description of the workings, geology, and ore bodies of the King of the Ranges Tin Mine, Watsonville, North Queensland. JUNE.—Notes on coal mining at Mount Mulligan. (The coal is believed to belong to the Permo-carboniferous system.)—Particulars of the geology and mode of occurrence of the ores and coal seams of the mercury, copper, and coal mines Little River, Cork District, as well as of the operations which have been carried on. JULY.—Development and output of Queensland Mines. AUGUST.—The Starcke Gold Field (altered Palaeozoic rocks with acid lavas and tuffs and auriferous quartz in fissures—Rocks of Trias-Jura age—Recent basalt lava flows—Auriferous alluvium—Details of deposits and mines.) SEPTEMBER.—Different methods of "Stoping" at Kalgoorlie. OCTOBER.—Discovery of wolfram near Lake Eacham—Report on State smelting works and State assistance in the sale and disposal of ores—Ore buyers and ore-buying tariffs.

VICTORIA.

Journal of the Department of Agriculture, 1909, 7. Part 10.—Training boys at the Viticultural College, Rutherglen—The fruit export trade to the United Kingdom and Europe (a report on season 1909, giving information as to the exports of each kind of fruit, with the maximum,

minimum, and average prices realised)—Sherry, its making and rearing (continued from previous numbers)—Seed tests (notes on the examination of a number of seeds imported into Victoria and giving percentages of weeds present and germination values)—Oats for fattening sheep and lambs—The tomato weevil (gives a short description of this insect, *Desiantha novica*, with remedial measures against it)—French crab (an illustrated description of this variety of apple)—Silos and silage (a further series of notes from farmers in Victoria, giving their experience with silage in recent seasons. Specifications for the construction of silos are also given). Part **11.**—Advance of the "Silo" in the Lilydale district—Silos and silage—Dart's Imperial wheat (gives the history of this well-known "rust-proof" wheat, with notes as to its milling qualities, etc.)—Irish potato blight and its treatment—Sherry: its making and rearing—Potato experimental fields—Manure experiments with potatoes. Part **12.**—Analyses of samples of lead arsenate. Grape stemmers (illustrated description of machinery for crushing and stemming grapes)—Vineyard cultivation (a discussion of "deep" *versus* "shallow" ploughing)—The prickly pear—Vegetable pests—Production and marketing of beeswax—Development of agricultural production in Victoria—Seed tests (an account of the results of a number of tests made on seed imported to Victoria).

Department of Mines. Records of the Geological Survey, 1909, Vol. **3**, Part 1.—Contains details of auriferous lodes and deposits in a number of localities; of lignite and a good plastic clay near Kilmore; the Toora tin deposits; the serpentine area, Wellington River, Gippsland, with chrome-iron ore and corundum; copper lodes at Sardine Creek and Snowy River; Mt. Deddick and Accommodation Creek, East Gippsland, with silver-lead and copper lodes, tin ore at Koetong and Cudgewa; silver-lead ore at Pine Mountain. There is a map of the State, showing in red the localities referred to.

Memoirs of the Geological Survey, 1909, No. **7**. *The Deep Leads of Victoria.*—Deals with the origin, structure, and distribution of deep leads (buried channels containing auriferous alluvium at a depth of not less than a hundred feet), the effect of earth movements, basalt covering, presence of water, methods and cost of mining, details of deep leads in the different alluvial centres, with numerous photographs, plans, and maps. The district maps are on a scale of two miles to the inch. No. **8**. *Report on the Lower Powlett, Cape Paterson, and Inverloch. Quarter Sheets;* 67 N.E., 67 S.E., and 76 S.W.; in the extreme south of the State. The rocks include Silurian; Jurassic (with coal); the Powlett beds, which are probably Eocene; Quaternary deposits and basalt dykes and necks. The maps, which are printed in colours, are on the scale of two inches to the mile.

NEW SOUTH WALES.

Agricultural Gazette, 1909, **20**. Part **10**.—Irrigation in Italy—On the discrepancy of the results obtained by manuring experiments in pots

and in the fields—*Phalaris commutata*, so-called—Feeding of pigs (analyses of various cereal mill products suitable for this purpose)—Agricultural Co-operative Societies in Australia—Margarine (a *résumé* of information on butter substitutes of this type, with notes on legislation affecting the industry—Harvesting—Harvest hints—Harvest-time (a report on the harvesting of hay and grain in the Central Western division)—Harvest in the Riverina—Harvest in the South Western district, etc.—Harvest methods (a series of notes on the harvesting of wheat, etc., for grain and hay, by experts and farmers who have had experience of this work in New South Wales). Part **11**.—Locusts in Australia and other countries (gives a full account of the methods of destruction adopted in countries where locusts are prevalent—Some practical notes on forestry suitable for New South Wales (this section deals with poplars)—Teff grass—Chemical notes (gives information regarding the manurial values of tobacco stalks and ash, and of tanyard refuse)—Cultural methods for wheat in dry districts—Certain fungoid diseases of potatoes, including "Irish blight" (general descriptions, with remedial measures, are given)—Dural demonstration orchard (a description is given of this orchard, which is to be used for carrying out experiments on fruit growing)—The harvesting of malting barley—Lucerne hay-making—Tobacco notes (gives information regarding types of tobacco suitable for cultivation in Australia. Part **12**.—Preserved fruit trade in Great Britain (a report on the sources and trade in currants, raisins, and other dried fruits)—On some plants which cause inflammation or irritation of the skin, Part II—Some useful Australian plants (*Andropogon brevifolius* is dealt with in this part of this series; it is suggested as a fodder plant)—Some granite soils of New South Wales—The possibility of finding phosphate deposits in Australia—Notes on flour strength—Artesian irrigation—"New South Wales strong white" (it is proposed to apply this name to certain of the new "strong" cross-bred wheats produced by the Department of Agriculture).

Records of the Geological Survey, 1909, **8**. Part 4.—Contains miscellaneous information. (Notes on the estimation of thoria in thorianite, the colorimetric estimation of small amounts of platinum; lode material from Broken Hill containing copper, nickel, platinum, and platinoid metals; numerous paleontological papers and some notes on the physiography and geology of the Macquarie River.)

Annual Report of the Department of Mines for 1908.—The total value of the mineral output was £8,609,607, showing a decrease of nearly two millions sterling. The production of coal and coke, lime, cement, and zinc increased, while that of alunite, antimony, bismuth, chrome, copper, diamonds, gold, iron, lead and silver, molybdenum, opal, platinum, oil shale, tin and tungsten decreased.

NEW ZEALAND.

Mines Record, 1909. APRIL.—Outline of New Zealand geology (continued)—The water power resources of Westland (South Island).

MAY.—The Parapara iron-ore deposits (these are in the north-west of the South Island, and consist of hydrated ferric oxide. There are over twenty-two million tons of ore, containing 50 per cent. of metallic iron).

BRITISH GUIANA.

Journal of the Board of Agriculture, 1909, 3. No. 2.—The Demerara Silk-worm (a descriptive account of *Attacus hesperus*, with directions for rearing the cocoons for the production of silk)—The question of a banana industry (describes the cultivation of bananas, and gives statistics of the industry in various countries *à propos* of the proposal to form plantations in British Guiana)—The experimental error in field trials (gives an abstract of Mr. A. D. Hall's recent paper on this subject, and discusses its application in the case of sugar-cane, rice, and cocoa field experiments carried out in British Guiana).

WEST INDIES.

Imperial Department of Agriculture, Pamphlet No. 62.—Seedling canes and manurial experiments at Barbados, 1907–09 (a summary of results).

Grenada. Reports on the Botanic Station, Experimental Plots, etc., 1908–09.—In the experimental plots attached to the Botanic Station trials with cocoa, Indian corn, Guinea corn, sweet potatoes, and castor oil plants were continued A new country experimental cocoa plot was established at Concord. At all the country cocoa stations and at the stations on various cocoa estates manuring experiments were continued. Attempts to grow cow-peas under cocoa failed; thus confirming previous experience that leguminous crops cannot be grown in heavy shade under cocoa. Good results were, however, obtained with cow-peas in open soil, so that wherever cocoa plantations are not entirely "covered in" it may prove useful to sow cow-peas or other leguminous plants in the open spaces with a view to improving the soil, and experiments on these lines with other leguminous plants are being continued.

Antigua. Reports on the Botanic Stations, Experimental Plots, etc., 1908–09.—The area under cotton in Antigua has decreased from 2,508 acres to 845 acres. This decrease is due to several factors, viz. bad seasons, insect attacks, and the low prices prevailing for cotton. Some extension of coconut planting has taken place, especially in the southern part of the island. Experiments with sugar cane varieties were continued at several stations. A large number of varieties of cassava are under trial at Skerretts'. A St. Kitts' sort named "Brown Stick" gave the best yield, viz. 11,200 lb. per acre, the next best being "Mullings" from Jamaica, which yielded 9,020 lb. per acre. The results of trials with sixteen kinds of sweet potatoes during the period 1900–09 are tabulated. The highest average yield was obtained from "T_1," and the next from "hen and chickens," the poorest average yield being given by "Quildon." A similar table for yam experiments shows that "light

red" gave the best average yield, whilst "sealed top" gave the second best, and "horn" the smallest. Experiments on the selection of cotton seed are being continued, and two new cottons, viz. "Centreville" and "Stirling," are under trial. Other products under experiment are "broom corn," "eddos and tannias," ground nuts, macaroni wheat (which did not do well), sesame, castor oil, etc. A number of leguminous crops are grown for use as green dressings, cow-peas and the Barbuda bean (*Phaseolus lunatus*) giving the best results of the products tried this year.

Montserrat. Reports on Botanic Station and Experimental Plots, 1908–09.—At Grove Station the experiments on the effect of planting "Sea-island" cotton at different distances apart were continued. The results so far are inconclusive. "Stirling" cotton gave a poor yield of seed-cotton and was subject to mildew, though the plants grew vigorously. Selection experiments were made on the "Rivers," "Stirling," and "Gilbert" cotton types. The lints from the selected kinds were valued separately by experts, who classed the first three in the following descending order: Stirling 9, Stirling 8, Rivers 7. Seed from these plants and from other selections will be sown next season. At Harris' Station experiments with Porto Rico, Dominica and local varieties of "tannias" were made, and manuring experiments with "Canary bananas" were continued. The area under cotton in the island increased from 2,100 acres to 2,250 acres, but the season was unfavourable and the exports amounted to 238,959 lb., valued at £12,000, the price realised being from 1*s*. 0½*d*. to 1*s*. 2*d*. per lb. Experiments with plantations of lime trees show that clean cultivation tends to increase the vigour of the trees, to promote early bearing, and to increase the crop. As this method of cultivation may lead to the exhaustion of the soil, "pen" manure has been applied to a portion of the clean cultivated crop. So far this manuring has had the effect of increasing the vigour of the trees, but from this manured portion smaller yields of limes have been secured. Small plantations of bay trees and of jaborandi plants have been formed.

St. Vincent. Reports on Botanic Station, etc., 1908–09.—The acreage under cotton showed a decrease, owing to low prices for cotton. The exports of "Sea-island" cotton were valued at £28,971, and of "Marie Galante" cotton at £907. Arrowroot continues to be the principal crop, and 5,194,727 lb. was exported. Unfortunately, only low prices were obtained, and the outlook for this industry is unsatisfactory. Steps are being taken to improve the cocoa produced in the island.

St. Kitts—Nevis. Reports on Botanic Station, Economic Experiments, etc., 1908–09.—Thirteen varieties of sweet potatoes are under trial, and experiments with varieties of cassava, yams and ground nuts are in progress. Havana and Sumatra tobaccos were tried, the plots being manured with potassium sulphate, with a view to improving the burning quality of the leaf, which has proved unsatisfactory in former experiments. Manurial experiments with cotton have been continued at St. Kitts, but

as in former years the results indicate that manuring is unremunerative so far as this crop is concerned. The area under cotton in the three islands, St. Kitts, Nevis, and Anguilla, during the year was 4,000 acres—a decrease of 1,000 acres from the previous year.

Tortola, Virgin Islands. Report on the Experimental Station, 1908–09.—Experiments on cotton, cocoa, coffee, pine-apples, limes, seedling canes, sweet potato varieties, cassava varieties, and arrowroot were continued. The cotton industry shows continuous progress, the exports for the year being 52,528 lb., as compared with 32,520 lb. in the previous year. A consignment of concentrated lime-juice was shipped to London during the year.

General information regarding agricultural industries in 1908–09 in the Leeward Islands is also contained in *Colonial Reports, Annual Series,* No. 629 [Cd. 4964–3].

Trinidad. Department of Agriculture. Circulars.—No. 2.—The Carpenter bird and cacao. No. 3.—Courses of reading and examination in practical agriculture. No. 4.—Strongylus parasites in cattle.

British Honduras. Report on the Botanical Station, 1908.—Experiments on rice, pigeon peas, yams, ginger, arrowroot, and cotton are in progress. It is mentioned that the logwood industry of the Colony has now become of small value, and the question as to what can take the place of this formerly important export requires serious consideration.

CANADA.

Report of the Minister of Agriculture, 1908–09.—Gives a summary of the work done by the various branches of the Department, including that of the Experimental Farms, dealt with in greater detail in the reports noticed below. The reports of the Canadian delegates to the Rome meeting of the International Institute of Agriculture are also printed.

Experimental Farms Reports, 1908–09.—(Compare this *Bulletin,* 1909, 7. 230.) These reports contain an account of the very large amount of experimental work in all branches of agriculture carried out during the year. The Director reports that the experiments in the cultivation of wheat, barley, root crops, etc., at Fort Vermilion, Peace River have been continued, and good results were obtained owing to the favourable character of the season. The wheats that have given the best results in this far northern district so far are "Preston," "Ladoga," "Early Riga," and "Riga," which can be sown early in May and cut about August 21. Experiments on the value of various fertilisers on common farm crops have been carried on systematically since 1887–8, and the usual tables of average results since that date, and results for the year under report are given. The chief data so far deduced are that (*a*) barnyard manure is most economically used in the fresh or unrotted condition, (*b*) finely-ground mineral phosphate is of little value as a manure, (*c*) ferrous sulphate is of little use in increasing

crops, (*d*) common salt is a valuable manure for barley, but is of little use for oats or wheat, and that the same is true of calcium sulphate.

In the report of the Chemist further progress in the investigation of the influence of environment on the composition of wheat is recorded, and the conclusion that the proportion of protein is markedly affected by the moisture content of the soil during the period of the development of the grain is confirmed. It is also shown that wheat may remain very wet for a considerable time in store without its composition being materially affected, provided the conditions are such as to preclude heating and fermentation. Determinations of the nitrogen content of rain and snow have again been made, and the figures obtained were about twice as high as those of the previous year, due, it is thought, to the smoke-laden atmosphere produced by extensive forest fires in this year. As usual, a large number of analyses of manures, feeding-stuffs, insecticides, etc., were made.

The report of the Cerealist contains *inter alia* the results of a series of baking trials with flours from damp wheat (see above). These indicate that up to a certain point wheat may be kept in a damp state without causing any deterioration in flour made from it. In this trial the damp wheat improved up to the 20th day, and then deteriorated so far as baking quality of its flour was concerned. This report also gives particulars of the seed selection experiments in progress with wheat, oats, barley, rye, peas, flax, root crops, etc. The last section of the volume contains the reports of the Superintendent of the Experimental Farms in Manitoba, Maritime Provinces, Saskatchewan, Central Alberta, Southern Alberta, and British Columbia.

Department of Mines, Geological Survey Branch, Nos. 980 and 1081. *Reports on* (1) *a Portion of Algoma and Thunder Bay Districts, Ontario, and* (2) *on the Region lying North of Lake Superior between the Pic and Nipigon Rivers, Ontario.*—Pre-cambrian rocks—Laurentian, Keewatin, Keweenawan and associated eruptives—occupy the whole of these areas, with the exception of the north-east portion, where, in the Albany River basin, argillaceous dolomites were found containing fossils of "Cambro-Silurian" and Silurian age. Glacial clays cover the older rocks of the more northerly district, and form good soil for agricultural purposes where the slope is steep enough to afford proper drainage. The economic mineral resources are not of much importance, though gold, pyrite and zinc blende have been worked to some extent. The reports are illustrated by plates and a geological map on the scale of eight miles to one inch.

No. 1035. *The Coal Fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia.*—This report embodies information contained in many scattered publications, together with much that is new, and forms a concise account of the coal-fields of the central parts of Canada. The coal of this region is of Cretaceous age. The coals from the Edmonton-Laramie formations are all lignites; the Belly River coals grade from true coal to lignite, with coking coals in the disturbed

area towards the Rocky mountains; and the Kootanie coals range from coking coals to anthracites. The analyses given include not only those of coals from the regions considered, but also those of practically all the Canadian coals previously examined, as well as several analyses of coals from the United States and other countries. The report is illustrated by eleven plates reproduced from photographs, and is accompanied by a geological map and section on the scale of 35 miles to one inch.

No. 1073. *Catalogue of Publications of the Geological Survey.*—This includes classified lists of all maps and reports published by the Survey between 1843 and January 1, 1909.

No. 1085. *A Descriptive Sketch of the Geology and Economic Minerals of Canada.*—The need of a concise and up-to-date account of the mineral resources of Canada, as well as of its general geology, must have been felt by many. The present work supplies this want in an admirable way. Owing to the vast extent of the Dominion and the abundance and variety of its mineral wealth, it is impossible to give full details in a hundred and fifty pages of letterpress; but the work of selection and generalisation has been carefully done. A chapter is devoted to each of the geological provinces into which Canada is naturally divided, viz. the Appalachian region, the St. Lawrence lowlands, the Laurentian plateau, the Arctic archipelago, the Interior Continental plain, and the Cordilleran region. The broad features of the geology of each of these provinces are first described, then follows an account of the economic minerals, with a tabulated summary. The last chapter deals with the glacial period in Canada. The book is illustrated by eighty-two photographic reproductions, and there are two useful maps showing respectively the mineral occurrences and the geology of the Dominion.

Quebec.

Report on Mining Operations in the Province of Quebec, 1908.—The mineral products include iron ochre, chromite, copper, gold, asbestos, and cement. Important deposits of magnesite have been discovered. Little has been done with lead, zinc, cobalt, silver, mica, phosphate of lime, graphite, molybdenite, felspar, barytes, or manganese, though these exist in the province. Details are given of exploration in the neighbourhood of Shining Mountain, Labrador, where iron ore (magnetite) of no economic value at present was found, and in the regions of lakes Chibougamau, Doré, David and Asinichibastat. Here deposits of copper and gold-bearing sulphides are met with, but do not appear to be as a rule of much importance. Veins of magnetite also occur as well as of serpentine-asbestos, which is in some places of good quality.

British Columbia.

Annual Report of the Minister of Mines, 1908.—Contains mineral statistics, reports from different districts, miscellaneous reports on indi-

vidual mining operations and the results of the inspection of metalliferous and coal mines.

GENERAL COLONIAL AND INDIAN PUBLICATIONS.

In the following paragraphs a summary is given of the more important contents of the chief Colonial and Indian periodical publications received recently at the Imperial Institute, in so far as these relate to agriculture or to economic products and are likely to be of general interest.

UGANDA PROTECTORATE.

Colonial Reports. Miscellaneous, No. 65. *Report on the measures adopted for the suppression of sleeping sickness in Uganda.*—A report by the Governor of the Protectorate giving a historical *résumé* of the outbreak of this disease, the scientific investigations made in connection with it and the measures adopted to prevent its spread. These latter include the removal of the native population from fly-infected areas near the lakes, the formation of segregation camps for victims of the disease and the clearing of dense, shade-giving vegetation from infested areas and the replanting of these with citronella or lemon grass.

Official Gazette, 1909, **2**, No. 38 contains, *inter alia*, a further note on the disease known locally as Muhinyo (this *Bulletin*, 1909, **7**. 347), confirming the previous conclusion that it is identical with Malta fever. The Cacao fruit fly (a description of this insect, *Ceratitis punctata*, is given and spraying with a solution containing lead arsenate and sugar is recommended as a remedy. Destruction of all infested pods by burning or by burial at a depth of at least two feet is also suggested)—Cotton cultivation (a note by the Provincial Commissioner on cotton-growing in the Kampala and Mubendi districts). No. **39.**—Cotton-growing in Bukedi (the Provincial Commissioner of the Eastern province states that the cotton-fields in this district are in good condition, and that no difficulty is anticipated regarding transport of the cotton)—A Report by the Imperial Institute on Black Rattler cotton is published. No. **42.**—Tobacco expert's Report for October 1909, and a report by the Imperial Institute on the first crop of Turkish tobacco produced in Uganda.

ZANZIBAR.

Report on Administration, Finance and General Condition of the Zanzibar Protectorate. Africa, No. **4.** 1909.—Section IV. of this general report deals with economics, and gives an account of the present position of agricultural industries. The clove crop in 1907 amounted to 167,000 bales, which is larger than for any previous year. The export of copra in the same year amounted to 143,163 cwt., which showed a decrease on that of the previous year. Both Ceara

and Para rubbers are being grown, as well as nutmegs and vanilla. Raphia fibre is obtainable in quantity from wild plants, and experiments with cotton are being tried. The cultivation of Sisal hemp has also been suggested, but it is not considered advisable that this industry should be taken up at present owing to the scarcity of labour.

NYASALAND.

Government Gazette, 1909, 16. No. 10, Supplement No. 4.—Notes on Cotton Cultivation in Nyasaland (A series of notes by the Director of Agriculture for the use of cotton planters). For the Upland districts, "Nyasaland upland" cotton is recommended, and planters are advised to select seed for sowing only from the best plants, in order that this cotton may improve continuously. The occurrence of a new cotton pest is recorded. This is an *Acronycta* sp., which attacks the stems of cotton plants. So far it has only appeared in a restricted area near Zomba, and is easily destroyed. Planters are urged to do their utmost to exterminate it, as otherwise it may become a troublesome pest.

SOUTHERN NIGERIA.

Government Gazette, 1909, 4. No. 61, Supplement.—Instructions regarding fungoid disease of Para rubber plants (notes that a fungoid disease and also a scale insect have been observed attacking leaf stalks and young shoots of Para rubber in the Mamu reserve plantations. It is recommended that infected leaves and shoots should be cut off and burnt, the wounds being treated with coal-tar or creosote)—Preliminary report on bollworm attacking cotton (this is provisionally identified with the Sudan bollworm *Diparopius castanea*. Cotton growers are recommended to cut off all affected bolls and burn them)—Annual report on the Eastern Province for 1908 (The export of cocoa increased by 148,655 lb., coffee exports have almost ceased, whilst fibre has increased by 1,787 lb. and rubber has decreased by 97,426 lb., mainly due to fall in prices. Experiments in the coagulation of *Funtumia elastica* latex with carbonate of potash and with acetic acid are said to have given good results, the product having been valued at 3*s*. 10*d*. per lb. for ball rubber, and 5*s*. per lb. for biscuit rubber. Sixty thousand Para rubber seeds have been received from the Straits Settlements, of which 10,850 have been sold to native planters, 15,000 have been sown at out-stations, and the remainder in the Botanic garden nurseries)—Trade Report for the year 1908 (The principal increases in exports for the whole Colony are cocoa, £2,700; maize, £23,100; fibre, £2,600; gum, £4,500; mahogany, £7,900; shea nuts and butter, £9,600; tinstone, £55,600. The following exports showed decreases: cotton, £43,700; cotton-seed, £4,900; ground nuts, £2,700; palm kernels, £233,700; palm oil, £159,000; rubber, £146,400; and skins, £6,100; the total decrease in value of exports for the year being £527,421 compared with 1907.

GOLD COAST.

Government Gazette, 1909.—No. 78 contains the report of the Agricultural Department for 1908. This opens with a statement on the agriculture of the Colony, referring to recent work on oil palms (this *Bulletin*, 1909, 7. 120 and 366), rubber, cola, cotton, copal, etc., and describes the position of these industries in the Colony. Descriptions of the various agricultural stations are then given, followed by reports on the work done at each of these during the year under review. The *Funtumia elastica* plantations at Aburi continue to do well, but the trees are not sufficiently developed to be tapped. A successful agricultural show was held at Coomassie in December 1908, at which a great variety of products cultivated by the Department was shown. A number of reports from the Imperial Institute on Gold Coast products are printed. No. 79.—This contains the Governor's address in presenting the estimates for 1910 to the Legislative Council.

STRAITS SETTLEMENTS.

Colonial Reports, Annual, No. 622, *Report for* 1908.—It is mentioned that the planting of Para rubber in the Colony continued to increase, but that there are considerable areas of waste land still available in Singapore where this tree might well be planted. The cultivation of indigo and citronella grass shows some increase. A trial with soy beans did not give good results. The high prices ruling for copra induced large imports of inferior copra from Muar and Malacca.

WEST INDIES.

Trinidad and Tobago Colonial Reports, Annual, No 621, *Report for* 1908–09.—A considerable amount of development work was done during the year in boring for petroleum by two of the companies now operating, and gushes of oil were obtained on both concessions. The total output of manjak was 1,170 tons, a reduction of nearly 1,000 tons as compared with the previous year. The asphalt exports diminished by £11,287, due to uncertainty as to the rate of duty likely to be imposed by the revised tariff in the United States. Experiments in the manufacture of paper from sugar-cane megass have proved successful, and a paper-making plant has been erected at Orange Grove. There are between 200,000 and 300,000 rubber trees planted, more than half being in Tobago, and though rather low yields of rubber are being obtained per tree, the industry is regarded as of great promise and importance to the Colony.

St. Vincent, Colonial Reports, Annual, No. 625, *Report for* 1908–09.—The cotton industry continues to develop, the total exports for the year being 459,303 lb., valued at £29,878. The cultivation is limited practically to the coast lands, and for that reason there cannot be much further expansion though it is hoped that an increased yield may be

secured when planters pay more attention to manuring, and the proper rotation of crops. The cultivation of cocoa is beginning to be taken up by planters and peasants.

Barbados, Colonial Report, Annual, No. 620, *Report for* 1908–9.—The cotton industry has somewhat diminished of late due to poor yields and low prices: the export of lint for the season 1907–08 was 988,443 lb., valued at £66,617, and it is expected that the area planted in 1909 will be even less than that of the previous year. 10,431 bunches of bananas were shipped to the United Kingdom at satisfactory prices, and it is considered that this industry could be largely increased if suitable arrangements could be made for the transport of the fruit.

NOTICES OF RECENT LITERATURE.

New Books.

Les Végétaux Utiles de L'Afrique Tropicale Francaise: Études Scientifiques et Agromoniques, publiées sous le patronage de MM. Edmond Perrier et E. Roume, dirigées par M. Aug. Chevalier. Fasc. III. *Recherches sur les Bois de différente espèces de Légumineuses africaines.* Par Em. Perrot et G. Gérard. Pp. vi. + 155. Fasc. V. *Première Étude sur les Bois de la Cote d'Ivoire.* Par Aug. Chevalier. Pp. 312. (Paris: A. Challamel, 1909.)

In the Third Fascicle of this valuable series the authors have set out to provide a reliable and scientific means of identification of the large number of timbers belonging to the Leguminosæ, which occur in tropical Africa. It is unnecessary to insist upon the desirability of such information, since it is well known that, apart from intrinsic qualities, the introduction of a new timber into commerce largely depends upon the certainty with which it can be identified until its frequency in the market renders it familiar to merchants and consumers.

In reviewing the criteria commonly relied on for the identification of timbers the authors point out that those based upon purely physical characteristics must necessarily be incomplete and often misleading: they recognise that the only available scientific method of identification, apart from appeal to botanical specimens, which is out of the question in commerce, must rest upon an anatomical basis. The work is divided into three parts. The first is chiefly concerned with a botanical discussion of the principal anatomical features of woody tissue. The historical aspect of the question is also dealt with, reference being made to the important work of Solereder, Müller, Nördlinger and others on the Continent, and to the determinations of physical constants and characters by Stone, the Imperial Institute and other authorities in this country. The second part constitutes the body of the work and contains the results of the authors' researches on some thirty species

of timber. The account of the nomenclature deals with the botanical synonomy, and gives the French, English and native names, the latter being especially useful since the tribal names for the same timber have been ascertained; an account of the distribution of the tree, so far as known, is appended. The botanical description of the tree is followed by a summary of the macroscopic features of the wood and bark and a detailed anatomical study of the wood itself. The information conveyed in the section relating to the physical constants is somewhat incomplete, but there has been no attempt on the part of the authors to deal fully with this aspect of the question. The third part consists of a brief summary of the conclusions arrived at.

The book contains a series of photo-micrographs of the timbers described, together with numerous line drawings of a diagrammatic character. The former are excellent, but share the disadvantage of nearly all published photographs of similar character in being far too small. It is probable that many of the line drawings will not perform any useful service, for it is upon matter of detail that many points in anatomical identification depend. The appendix of large folded sheets, presenting a summary of the characters of the timbers examined, should prove a great use in the primary identification of new specimens.

In Fascicle V, attention is once more directed to the ever-increasing scarcity of the most merchantable timbers of the world due to wasteful methods of felling and to the comparatively feeble efforts at conservation and re-afforestation in those countries which are the chief producers of the class of timber mostly in demand. M. Chevalier regards a crisis as inevitable in the near future, but believes that it may be staved off for a considerable period by an intelligent exploitation of the forests of the West Coast of Africa, especially those of the French Ivory Coast. He points out that the forest resources of West Africa are by no means of recent recognition, but that certain powerful factors have hitherto prevented their extensive exploitation, the most prominent being the supreme difficulty of transport, the attractions of gold-mining, and the evil reputation of the climate.

The valuable information contained in the volume has been obtained, largely at first hand, during an extensive tour through the forest region of the Ivory Coast. The virgin forest occupies an area of 120,000 sq. kilom. and extends, with one break referred to below, through the whole breadth of the Colony from east to west, and from south to north through nearly three degrees of latitude. It is then succeeded by a characteristic savannah, which is of great interest since it splits the forest into two regions by the extension of an enormous V-shaped portion penetrating southwards between the arms of the Bandama river to within 100 kilom. of the sea. The forest is very dense and of a most varied composition, it being estimated that the total flora comprises nearly 2,000 species, of which from three to four hundred are large trees over 60 feet high, with as many smaller species from 15 feet to 45 feet high. At the present time practically the whole of the forest awaits

systematic working, so far as its timber resources are concerned. The author is of opinion that a unique opportunity is afforded the Government of administering an enormous area of valuable tropical forest on scientific lines. He urges that the immediate necessity is the organisation of an efficient Forest Service whose energies from the outset shall be directed against the destruction of the forest, now being carried on in certain favourable districts by European timber-getters and their native agents, and by the agricultural natives in all parts of the country. The difficulty of the waste by the latter is met at its foundation, for it is shown that, until the people are compulsorily educated into better methods of cultivation, which demonstrate the possibility of raising successive crops from the same parcel of land, so long is it inevitable that the native system of first devastating and then exhausting successive areas of forest will be persisted in. The question of the organisation of transport does not receive perhaps the amount of attention it deserves, since it is obviously a matter of primary importance. Reference is made, however, to the railway transport of the Gold Coast and Southern Nigeria and the necessity for similar facilities in the Ivory Coast is urged: proposals for establishing light railways for cable-haulage trucks are also considered.

A large part of the volume is concerned with a description of the important timber trees met with during the journey. Over 150 species are fully described in relation to native and scientific nomenclature, distribution and uses. This part of the work contains a very full account of the chief species of Funtumia and of the rubber industry in the Colony; the identification of the Khaya yielding the Ivory Coast mahogany as a new species, viz. *K. ivorensis* (also reported from the Gold Coast) is recorded, and a useful account of the various timbers placed on the market as "West African Mahogany" is given.

M. Chevalier estimates that nearly fifty species of timber could readily find definite uses in Europe. In addition to the mahoganies, several species of Canarium, *Lonchocarpus sericeus*, *Macrolobium* sp. are recommended for joinery and cabinet-making; species of Piptadenia and Albizzia furnish ornamental woods suitable for furniture-making; while *Entandophragma ferruginea* and *E. macrophylla* (both new species), *Oldfieldia africana* and Téké form efficient substitutes for teak. Several species would be suitable for railway sleepers and possibly for paving blocks. Numerous white woods are also referred to, suggestions being made for their utilisation for wood-pulp. Finally, attention must be drawn to the excellent map which accompanies the volume. It has been compiled on a phyto-geographical basis and shows in a very clear manner the principal facts in relation to the distribution of economic plants and products in the Colony.

CANE SUGAR AND ITS MANUFACTURE. By H. C. Prinsen Geerligs. Pp. xi. + 350 + xvi. (Norman Rodger, Altrincham, Manchester, 1909.)

In this work the author who was for seventeen years Head of the

West Java Sugar Experiment Station, aims at presenting in an accessible form everything that is known about the chemistry and technology of the sugar cane and the manufacture of cane sugar. He excludes, however, details concerning the machinery of the sugar factory and refers the reader to Noël Deerr's book, *Sugar and the Sugar Cane* (reviewed in this *Bulletin*, 1905, 3: 377), for such information.

The author has been very successful in carrying out his task, since the numerous factors which influence the output and quality of the sugar are clearly described; the merits and defects of the various processes that have been devised as steps in the manufacture are discussed, and attention is drawn to precautions necessary in putting them into operation. Valuable tables are given embodying the results of the investigation of various points in the manufacture, which should be of great service in controlling the various operations of the factory.

The subjects treated of, are: The constituents of the sugar cane, their distribution and proportions in different parts of the plant at different stages of its growth and under varying meteorological conditions; the extraction of the juice, its clarification and concentration, the crystallisation of the sugar, the separation and utilisation of the molasses, but excluding an account of rum manufacture, and the preservation of sugar during storage and transport. Reference is also made to various micro-organisms attacking the sugar cane and its products.

The idea of utilising the crushed cane left after the juice has been extracted, which is known as "bagasse" or "megass," as a material for paper-making is often entertained, it is therefore of interest to note the author's opinion on the feasibility of this. He remarks that many attempts have been made to use it for paper-making, and that the result was satisfactory in many cases, but that although the prospects are very promising, paper is not yet manufactured from it on a commercial scale. Owing to the comparatively small quantity of cellulose in cane fibre, the large percentage of lignin and the quantity of soda required to remove the latter, the cost price of such paper must be rather high. In countries such as Louisiana, where fuel and chemicals are cheap, and where there is an abundant supply of pure water for washing the pulp, the manufacture may have a good prospect, but where chemicals and fuel are expensive, or where good water is scarce, the prospects are doubtful. The manufacture was started some years ago on a sugar estate in Texas, but had to be abandoned. Lately an enterprise at the Tacarigua Estate, Trinidad, is stated to be successful; here a fine wrapping paper, which can also be printed on, is made, but the bagasse (65 per cent.) is supplemented by Para grass (15 per cent.) and bamboo (20 per cent.). At the Cumberland Mills in Maine, Dr. Viggo Drewsen succeeded in making an excellent printing and letter paper solely from bagasse from Louisiana and Cuba. The average yield was 50 per cent., and the bagasse was heated under pressure with a large amount of caustic soda.

Another by-product of the cane sugar industry that is attracting

attention at the present time is "molascuit," which is used as food fo live stock. The author states that it consists of a mixture of 75 part of molasses and 25 parts of dry, fine parenchyma fibre (pith) of suga cane. It should not contain less than 45 per cent. of total sugar (sucrose and reducing sugars) and not more than 15 per cent. o moisture; it should be homogeneous and dry so that the bags in whicl it is transported do not sweat nor become stained, and the molascui itself should neither cake nor become sticky. The fibre used shoulc be exclusively that from the pith cells and not from the fibro-vascula bundles, as the pith fibre is much more absorptive and also more digestible than the latter, which is liable to exert an irritating action or the intestines.

The book is a good example of the value of scientific knowledge combined with practical experience.

Sugar. A Handbook for Planters and Refiners; being a comprehensive Treatise on the culture of Sugar Yielding Plants, and the Manufacture, Refining, and Analysis of Cane, Beet, Palm, Maple, Melon, Sorghum, and Starch Sugars, with copious Statistics of their Production and Commerce, and a chapter on the Distillation of Rum. By the late John A. R. Newlands and Benjamin E. R. Newlands, F.I.C., F.C.S., Pp. xxxvi. + 876. (London: E. & F. N. Spon, Limited, 1909.)

This is a new edition of a work published by Lock, together with Benjamin and John Newlands in 1888; it covers a wide range of subjects connected with sugar and its manufacture. Cane sugar and beet sugar cultivation and industries, owing to their magnitude, claim the largest amount of space, but accounts of other plants from which sugar is obtained commercially are also included, and thus make it a valuable work of reference, besides being a text-book of the manufacture of the two common sugars. It contains useful tables and numerous diagrams of the machinery used in sugar manufacture and rum distillation, and also figures of the sugar-yielding plants. By an oversight the frontispiece, which represents a group of palms some thirty feet high, is referred to on p. 27 as showing a plantation of black Tanna canes, which was the subject of the frontispiece of the earlier edition.

Le Cafe dans l'État de Saint Paul (Brésil). By A. Lalière. Pp. xvi. + 417. (Paris: A. Challamel, 1909.)

The State of San Paulo produces approximately one-half the world's supply of coffee; other States of Brazil also have large outputs, and altogether Brazil normally contributes about three-quarters of the world's annual coffee crop. In some years, notably recently in 1902–03 and 1906–07, Brazil actually produced far more than the total normal yearly consumption. As a consequence of such over-production the price naturally fell, and a very grave situation was created for Brazil, where, in 1907, the value of coffee exported was £28,500,000, or 52·7

per cent. of the total exports. The gravity of the situation may be realised by noting that in San Paulo, of the 450,000 workers employed in the industries of the State, no less than 420,000 are stated to be engaged in the production and transportation of coffee. Various steps have been taken to guard against the evils liable to follow excessive crops. The extension of the area under coffee has been checked and placed under control. The valorisation scheme is intended to allow a surplus to be placed on the market gradually without disturbing prices. More recently a Government scheme has been organised for advertising and otherwise advancing the interest of San Paulo and its chief product, with the object of increasing the consumption of coffee in various countries and of checking the adulteration, or rather substitution, which is stated to be practised to the detriment of Brazilian coffee.

These, together with many other matters of general interest, are discussed by Prof. Lalière, who has brought together in a convenient manner transcripts of various official documents and full statistical evidence relating to many phases of the world's production and consumption of coffee and, in particular, detailed commercial data relative to the Brazilian trade in this product.

To many, however, the special interest of the book will not lie in the discussion of the general economics of the coffee industry, but in the account of the cultivation and preparation of the crop as actually practised in San Paulo. This takes up the greater portion of the book, and is well done. All stages, from selection of land to the exportation of the produce, are well described to the accompaniment of an unusual wealth of illustrations. The latter alone, studied carefully, will afford a good general idea of the circumstances of Brazil's staple industry. Such a picture as the panoramic view of "Fazenda Guatapara," or those of the drying grounds, give a vivid idea of the magnitude of the operations of some of the Brazilian enterprises. At the same time some of them suggest possible dangers. The view over the fazenda or plantation, with its endless regular rows of bushes without even a single shade tree or a break of any kind, suggests the awful possibilities which might attend the introduction of a virulent, contagious coffee disease. The lesson to be learnt from the past history of coffee cultivation in the world is certainly not that of basing the prosperity of a State too exclusively on Arabian coffee grown in enormous unbroken areas.

The descriptive portion relating to processes involving the use of machinery has the advantage of showing a view of a machine (often in use) and a diagrammatic section of the same, frequently facing each other on opposite pages. The two coloured maps of the distribution of agricultural industries in Brazil and the plan of a coffee estate are also noteworthy.

As an account of the coffee industry of San Paulo the work is of great interest, and as San Paulo, as already noted, produces half the world's coffee, a good summary of the methods practised there should appeal to those interested in coffee in any part of the Tropics.

H

CORDAGE FIBRES: THEIR CULTIVATION, EXTRACTION AND PREPARATION FOR MARKET. By H. R. Carter. Pp. iii. + 112, with 15 illustrations. (London: John Bale, Sons and Danielsson, Limited, 1909.)

This work consists of a collection of articles which have appeared from time to time in the *Jute, Hemp, Flax, Rope and Twine Trades' Journal.* An account is given of all the most important vegetable fibres of commerce used in the manufacture of rope and textiles. Some portions of the book are fairly well written, but other portions are characterised by a looseness of expression and lack of accuracy which greatly impair the usefulness of the work. In a preface, the author expresses the somewhat extravagant hope "that the book will prove a valuable work of reference to those interested in the cultivation of Colonial and tropical fibres." Although this hope can hardly be realised, the volume will, nevertheless, probably be of some service to rope and twine-makers, as affording them a general knowledge of the source of their raw materials. There are numerous misprints, especially in connection with the botanical names, but these will doubtless be rectified in the next edition.

D'UNE RIVE À L'AUTRE DU SAHARA. Par le Lieut. Maurice Cortier. Pp. vii. + 409. (Paris: Emile Larose, 1908.)

This book, which is well illustrated and provided with three excellent maps, forms another addition to the long series of records and explorations carried out by French military officers in north-west central Africa. It is an account of a journey lasting over four months, during which time the whole of the country between Algiers in the north, and Cotonou on the seaboard of Dahomey, was traversed by the mission. The Sud-Oranais Railway was taken advantage of as far as its terminus at Colomb-Béchar on the south-west frontier of Morocco, when the journey began in earnest. The route lay first in a southerly and then in a south-westerly direction through the country of Adr'ar' until the elevated region of the Massif du Hoggar, in the latitude of the tropic of Cancer, was reached. Eastern Adr'ar', in the south central Sahara, was traversed towards the south-east, and then, the advance being more southerly, the Niger was reached at Gao Gao, some 300 kilometres due east of Timbuctoo. The course of the Niger was followed to Carimama, near the frontier of Northern Nigeria, whence the journey was continued through Dahomey. The total length of the route was nearly 4,000 kilometres, and almost the whole of the middle third of the journey lay through country hitherto unexplored by Europeans.

The first part of the book gives a detailed account of the incidents of the journey arranged in the form of an elaborated diary. The scientific results obtained by the mission are dealt with in the second part. The general geographical features of Adr'ar' are described, much of this information being available for the first time. The political and religious organisation of the Ifor'as—the Arab inhabitants of the country

—is then considered, and in subsequent sections the social life of these tribes is fully dealt with. The productions of the country would appear to be almost nil, for the greater part of the region is entirely desert. Practically the only industry is a small manufacture of leather from the skins of goats, sheep, camels, giraffes and antelopes. The sole wealth of the people would appear to lie in their animals, chiefly camels and sheep, and these are exchanged with caravans and the inhabitants of the distant oases for the necessaries of life. The appendix contains the results of a trigonometrical survey of the regions traversed.

LE CONGO BELGE. By J. Bertrand. Pp. x. + 147, with 103 illustrations and a map. (Brussels: Albert de Boeck, 1909.)

This little handbook, written from the standpoint of the geographer, contains a general description of the Belgian Congo. The history of exploration in Equatorial Africa is briefly traced, and the recent partition of the Continent amongst the great European Powers is graphically brought out by the map on p. 15, which contrasts the small European holdings in 1870 and the great possessions of the present, when Abyssinia, Morocco and Liberia are the sole remaining independent States. A general summary of the physical features and climate is followed by an account of the vegetation, as affected by the natural conditions; some of the illustrations, although small, afford a very good idea of characteristic types of plant associations, such as savannah, mangrove swamps, forests, etc. An instructive diagram is that on p. 64 illustrating the effect of altitude in determining the character of the vegetation. In a later chapter the economic aspects of the natural products are considered, and a short account is given of the rubbers, resins, fibres, food products, oil-yielding plants, ivory, etc., illustrated by pictures of some of the plants, and tables showing graphically the exports for a series of years.

The natives and the methods of administration are also dealt with, and the book, as a whole, affords a concise and convenient summary regarding the region with which it deals.

THE UNION OF SOUTH AFRICA. By the Hon. R. H. Brand. Pp. 192. (Oxford: the Clarendon Press, 1909.)

The author, who was the secretary to the Transvaal Delegates at the South African National Convention, has attempted in this volume to sketch the leading features of the South African Constitution. A preliminary chapter and an historical *résumé* serve to give the reader some idea of the complexities of the subject and of the various events which culminated in the passing of the South Africa Act, 1909. Political and economic considerations are treated on broad lines, and the work affords an interesting survey of some of the chief problems in the affairs of the new Dominion.

Restricting attention here to the economic questions, it may be noted that Mr. Brand points out that although the war decided the racial

conflict it did not put an end to the inter-state rivalries. The railway problem is an excellent example of the difficulties which encompass States in South Africa with separate financial interests, even when all under one flag. To understand the problem it is necessary to remember that the railways are State-owned; that the traffic to Witwatersrand is the most profitable and the prize for which Governments and ports have long contended; and that the three principal lines of access to the Rand are through the Cape ports, Durban and Delagoa Bay. In 1894 the Cape ports, and consequently the Cape railways, held eighty per cent. of this traffic; now they retain only about ten per cent. Natal's share has also decreased. On the other hand, the Portuguese port of Delagoa Bay now possesses sixty-seven per cent. of the Rand's traffic, the reason for this preference being that by importing goods from Delagoa Bay they pass over a greater mileage of Transvaal railways than if coming from other ports, with corresponding advantage to the revenue of the State. Lord Milner, shortly before leaving South Africa, at a conference held at Johannesburg in 1905, said: "It may be established on the most conclusive evidence that a particular line is in the general interest and would develop commerce and increase prosperity. Yet that particular line may be indefinitely blocked, because it is going to take money out of the pocket of a particular administration." With community of interest considerations of national rather than local advantage should prevail. The customs question, the native problem, and other important matters, afford equally good examples of the desirability of true Union. They are discussed temperately in this book, which should prove of general interest to all concerned in the future of South Africa.

AUSTRALIAN LIFE IN TOWN AND COUNTRY. By E. C. Bailey. Pp. viii. + 207. (London: George Newnes, Ltd., 1909.)

This book affords an interesting account of modern Australian life. The ordinary daily routine on the "station," on the "selection" and in the towns is graphically presented. Any one thinking of settling in the country or desirous of obtaining general knowledge of Australian affairs would find the volume of great utility. It possesses the advantage of numerous good illustrations. Economic and political questions are discussed in an impartial manner, both sides being usually presented, and the author avoids any *ex cathedra* statement of his own views. As an instance may be noted the presentment of the labour question in the northern and tropical territories, one of the most important problems Australia has to solve. On the solution depends not only the realisation of the great potentialities of these regions, but also to a large degree the future part Australia will play in the world.

The importance of climatic factors—particularly rainfall—in determining the economic development of the country is well brought out. The central portions of Australia are arid in comparison with the coastal belt. To this is largely due the distribution of the population; of the

total of 4,000,000 people no less than four-fifths live within 150 miles of the sea. Droughts in the interior lands are predominating influences, when unfortunately they occur for any length of time. In 1891 there were 124,000,000 sheep in Australia; a long series of dry years supervened, and in 1902 the number was reduced by more than one-half. Another illustration given is equally striking. In 1902–03, the last dry years of the series, the wheat crop was valued at £2,000,000. In 1904–05, from a slightly smaller acreage, the value of the crop was no less than £12,000,000. Details of the sufferings and trials of the agriculturists during such times are given by one who is evidently only too familiar with them, and practical means of guarding against similar occurrences in the future are discussed.

There are, of course, many brighter aspects presented of Australian life, but an important feature of the book is that the drawbacks of the country are not glossed over, and for this reason it should prove of the greatest service in helping any one to form a true picture of the actual conditions to be encountered in the Commonwealth.

THE COMMONWEALTH OF AUSTRALIA. By the Hon. Bernhard R. Wise. Pp. 355, with illustrations and maps. (London: Sir Isaac Pitman & Sons, Ltd., 1909.)

This volume is the first of a series which is to deal with the constituent parts of the British Empire beyond the seas. The author divides his subject into three sections. In Part I is given a general sketch of Australia as a growing nation, the opening chapter being devoted to "Physical Conditions." Subsequent chapters treat of "Bush Life," "Politics and the Working Man," "Education," "The Public Lands," etc. As evidence of the material prosperity of Australia and its inhabitants the following quotation from the conclusion of this first section may be given:—"Judged by any standard, whether natural resources, climate, individual prosperity, production, trade or commerce, a comparison with other parts of the Empire is in favour of Australia. She has only 4,119,000 people, yet the produce in agriculture and pastoral industries is £84,349,000; in forestry and fisheries, £4,879,000; in minerals, £26,643,000; and in manufactures, £31,172,000, making a total production of £147,043,000, or £35 19*s.* 10*d.* per head. At the same time her internal trade is £76,428,000 and her over-sea commerce £114,482,675, making a total per head of £46 14*s.* 7*d.* or £28 0*s.* 5*d.* per head for over-sea commerce alone.

Part II gives an account of the Government, with a sketch of the events which led to the formation of the Commonwealth in 1901. Part III is devoted to "Legislation," with chapters on "Tariffs and Preference," "Industrial Life," "The Commonwealth and Immigration," and "Defence." Good photographs and maps are included. The book is a valuable addition to Colonial literature and augurs well for the series of which it forms a part.

ACROSS PAPUA. By Col. Kenneth Mackay, C.B., M.L.C. Pp. xvi. + 192. (London: Wetherby & Co., 1909.)

In a recent article in this *Bulletin* (1909, 7. 84), an account was given of this little-known corner of the Empire and of its economic resources. That article was based mainly on data contained in the "Official Handbook," then recently published, and the report of the Royal Commission appointed in 1906 "to inquire into and report upon the present conditions, including the methods of government, of the territory now known as British New Guinea, and the best means for their improvement." Colonel Mackay was chairman of that Royal Commission, and the present volume contains an account of the journeys made in carrying out its objects. These journeys included one across the Territory from the capital, Port Moresby, to Buna Bay, and coasting trips in the yacht, *Merrie England*, in the course of which the whole of the coastline, from Keremah Bay to Port Douglas, was visited, in addition to the chief outlying islands, such as Woodlark Island and the Trobriand Group. It seems clear from the author's observations that excellent work is being done by the small band of planters, officials, medical men, missionaries and others who have settled in the Territory, in developing its resources, improving the most unhealthy districts by the clearance and drainage of swamps, and by educating the natives. Altogether, Colonel Mackay takes a hopeful view of the future of the Territory, though he nowhere minimises the difficulties presented by the climate, the primitive habits of the natives, and their indolence.

The book is eminently readable, and its pages are frequently enlivened with anecdotes, which serve better than pages of description to illustrate the habits and characters of the Papuans. There are a few obvious "printers' errors" which have escaped correction, such as "batchelor" on p. 76, and "Papau" on p. 183. The book is provided with a useful map showing the route followed by the author, and is illustrated by a series of good reproductions from photographs.

VON DER HEYDT'S KOLONIAL-HANDBUCH. JAHRBUCH DER DEUTSCHEN KOLONIAL- UND UEBERSEE-UNTERNEHMUNGEN. Third annual issue. Edited by Franz Mensch and Julius Hellmann. Pp. xxxii. + 287. (Berlin, Leipzig and Hamburg: Verlag für Börsen und Finanz-Literatur A.-G., 1909.)

This work gives a complete survey of the Colonial and foreign undertakings of Germany. The imports and exports of each of the German Colonies for the years 1903–07 are tabulated. Particulars are given of the various trading, land, mining and planting companies, including a statement of the general position, capital, last balance and dividend of each, as well as of its purpose and sphere of action and the members of its directorate.

THE LINEN, HEMP AND JUTE TRADES' DIRECTORY. Compiled by H. R. Carter. Pp. 152. (Belfast: Carter, 1909.)

This work gives the names and addresses of British and foreign spinners of flax, hemp and jute, and also of merchants and brokers, of finishers, bleachers and dyers, and of manufacturers of machinery and accessories. It appears to have been carefully compiled and will probably prove very useful to the trades concerned.

COLONIAL AND INDIAN COLLECTIONS.

WEST INDIAN COURT.

WINDWARD ISLANDS EXHIBITS.

THE islands of Grenada, St. Vincent and St. Lucia, with the islets called the Grenadines, are grouped together for administrative purposes and known as the Windward Islands.

GRENADA.

Grenada, the most southerly island of the group, is 68 miles S.S.W. of St. Vincent, and 90 miles north of Trinidad. It is about 21 miles in length by 12 miles in breadth, and contains—including Carriacou—some 133 square miles, *i.e.* about half the area of Middlesex. Some of the Grenadines are attached to Grenada as a dependency; of these Carriacou, the largest and the most important, is about seven miles long, varies in width from one to two miles, and has an area of thirteen square miles.

Grenada is a picturesque island of volcanic formation, with a backbone of thickly wooded mountains running north and south. The highest point is Mount St. Catherine, 2,749 feet. From the centre of the island mountainous spurs radiate to the coast in all directions. Springs and streams are numerous. There are two crater lakes, the better known being the Grand Etang, at an elevation of 1,740 feet; the other is Lake Antoine.

The mean temperature is about 70° F., the heat being tempered by the regular trade winds. The rainfall is close upon 80 inches in the south, and reaches 160 inches in the north and centre. The island lies outside the usual path of hurricanes. The chief town is St. George's, situated on an almost landlocked harbour. It offers great facilities to shipping as a port of call, is healthy and possessed of a good water supply. The products of Grenada, in order of importance as exports, are cocoa, spices (chiefly nutmegs) and cotton. Sugar, formerly the chief crop, is now produced on a very small scale. Amongst other minor crops are coffee, cola-nuts, cardamons and coco-nuts. Fruit is abundant, oranges in particular being of fine quality. The forests contain good timber, of which but little use is made, but firewood is exported to the comparatively treeless Barbados. Live stock—goats, sheep, pigs and poultry—are also exported.

Vegetable Products.

Cocoa (*Theobroma Cacao*).—The cultivation and preparation of cocoa is by far the most important industry of Grenada. In former days sugar was the staple crop, but with the abolition of slavery cocoa planting was systematically taken up, and the island is now quite independent of sugar as a commercial crop. There are several large cocoa estates, but a very considerable portion of the crop is produced by the peasantry on small holdings. The plant thrives from the sea-level up to about 1,000 feet; above 800 feet the yield is uncertain, and about half this elevation is probably the most suitable.

The average value of the export during recent years has been over £250,000.

Exhibits—

Cocoa pods, whole and in section.

Cocoa beans, sun dried and artificially dried.

Chocolate, native made.

Nutmegs, Mace (*Myristica fragrans*).—Spices come next to cocoa amongst the exports of Grenada. The most important are nutmegs, the seeds of the nutmeg tree, which is widely grown throughout the island. Mace, the dried arillus which forms a brilliant scarlet network over the inner shell of the ripe nutmeg, is also exported. The outer succulent part of the fruit is used locally as a fruit or made into preserve.

Exhibits—

Nutmegs, whole fruits.

Nutmegs, shelled. Nutmegs, unshelled.

Other Spices.—In addition to nutmegs, various other spice plants—all introduced—are cultivated, but none on such a scale as to be of great commercial importance.

Exhibits—

Cardamons, specimens in formalin and dried. Cinnamon bark.

Vanilla, specimen in formalin. Cloves.

Cotton.—This product occupies the third place in the list of exports. The industry is not practised to any extent in Grenada itself, but is almost entirely restricted to the small island of Carriacou. This cotton industry is of special interest, inasmuch as, previous to the recent revival of cotton cultivation, Carriacou was the only place in the West Indies in which the industry had lingered on from early days. The varieties cultivated are Sea Island and Marie Galânte, the latter being a harsh, woolly cotton of the Peruvian type.

Exhibits—

Sea Island Cotton, fruiting specimen in formalin.

Sea Island Cotton, seed cotton and lint.

Marie Galânte Cotton, lint.

Coffee.—Arabian coffee (*Coffea arabica*) and Liberian coffee (*C. liberica*) are both cultivated for local use.

Exhibits—

Liberian Coffee, fruiting specimen and cherries in formalin.
Liberian Coffee, dry cherries, in parchment and cleaned.

Cola (*Cola acuminata*).—Cola trees—introduced from West Africa—are cultivated, and the dried seeds or "nuts" are exported to the value of about £300 annually. The physiological value of the seeds is chiefly due to their containing the alkaloid caffeine, and thus possessing the properties of a stimulating food.

Exhibits—Cola Nuts.

Sugar (*Saccharum officinarum*).—The cultivation of sugar-cane is now practised only on a small scale and sugar of poor quality is made for local consumption, but in insufficient quantity to satisfy even the requirements of the labouring classes, so that there is a considerable importation of sugar. Rum is also made for local consumption.

Exhibits—

Muscovado Sugar. Molasses. Rum.
Rum Shrub—a liqueur made of rum, lime juice and sugar, with various flavouring materials.
Falernum—Rum, lime juice and sugar are the essential ingredients, with various flavouring materials.

Tonka or Tonquin Beans (*Dipteryx odorata*).—The seeds of a Guiana tree, prepared for the market by a process of sweating or fermentation. They are very fragrant—due to the presence of coumarin—and are used in various ways on account of their perfume.

Exhibits—

Fruits of *Dipteryx odorata* in formalin.
Tonka or Tonquin beans, as prepared for sale.

Ginger (*Zingiber officinale*).—The underground stems or rhizomes of this plant, cleaned and dried, form the ordinary ginger of commerce. Ginger is grown on a small scale in Grenada.

Exhibit—

Ginger rhizomes—in formalin.

Fruit.—Grenada has a high reputation in the West Indies for the variety and quality of its fruits. The various citrus fruits are especially good, although not systematically cultivated. The following list of exhibits will give some idea of the resources of the island as regards fruit cultivation.

Exhibits—

Sweet Orange (*Citrus Aurantium*).
Mandarin Orange (*C. nobilis*).
Tangerine Orange (*C. nobilis*).

Seville Orange (*C. Aurantium* var. *Bigaradia*). Citron (*C. medica*).
Lemon (*C. medica* var. *limonum*).
Lime (*C. medica* var. *acida*). The most important citrus fruit of the tropics; the source of lime juice and essential oil of limes. It is also in great demand as a fresh fruit.
Custard Apple, or Cœur Bœuf (*Anona reticulata*).
Mango (*Mangifera indica*). Introduced from the East, and largely grown as an edible fruit.
Guava (*Psidium Guajava*). The fruits are usually eaten stewed or in the form of guava jelly, a sample of which is also shown.
Papaw (*Carica Papaya*). The substitute for the melon in the tropics, and the source of the drug "papain," prepared from the latex of the unripe fruit.
Sweetcup (*Passiflora maliformis*). The pleasant edible fruit of a passion-flower.
Granadilla (*Passiflora quadrangularis*).
Tamarinds (*Tamarindus indica*). Well known for the medicinally laxative pulp which surrounds the seeds.
Carambola (*Averrhoa Carambola*). Acid fruits which are eaten as preserves, pickles, etc.
Star Apple (*Chrysophyllum Cainito*). A characteristic West Indian fruit, but not appreciated by every one owing to the latex contained in the pulp.
Barbados Gooseberry (*Cicca disticha*). The fruits of a small tree of the Euphorbiaceæ. They are pleasantly acid, and are made up into tarts, etc.
Cashew (*Anacardium occidentale*). The fleshy portion, really the enlarged stalk, may be made into tarts, etc. The kernels are excellent as dessert nuts when properly roasted.
Chili plum (*Spondias* sp.) Pine-apple (*Ananas sativus*).
Rose Apple (*Eugenia Jambos*).
Red Sorrel (*Hibiscus Sabdariffa*). The fleshy red calyx (the outer part of the flower) is cooked as a fruit, and also employed in the preparation of a pleasantly acid fermented drink known as "sorrel wine."

Cereals.—In tropical countries which do not produce rice the most important cereals are frequently maize and sorghums. In Grenada they are grown for local use.

Exhibits—
Indian corn. Maize Cobs (*Zea Mays*).
Guinea Corn (*Sorghum vulgare*).

Starches and Meals.—Various starches and meals are prepared on a small scale by simple means for local use.

Exhibits–

Cassava meal (farina) and starch (*Manihot utilissima*).
Arrowroot starch (*Maranta arundinacea*).
Bread fruit starch (*Artocarpus incisa*).
Guinea corn starch (*Sorghum vulgare*).

Pulses.—Pulses in the tropics commonly form an important part of the dietary of the peasantry. Pigeon peas in the West Indies are largely eaten boiled with Guinea corn, rice, etc.

Exhibits—

Sword beans (*Canavalia ensiformis*). Pods and dried seeds.
Pigeon Pea (*Cajanus indicus*). Fruiting branches and seeds.

Oils and Oil Seeds.—These are produced only on a very small scale.

Exhibits—

Sesame or Sim Sim (*Sesamum indicum*), they yield Gingelly oil.
Castor Oil seeds (*Ricinus communis*) and Castor Oil.
Coco-nut Oil (*Cocos nucifera*).

Fibres.—Fibre plants have been introduced experimentally into Grenada, but they are not the basis of any considerable local industry.

Exhibits—

Langue de bœuf (*Fourcroya cubensis*), similar to Mauritius hemp.
Sisal fibre (*Agave rigida* var. *sisalana*).
Bowstring hemp (*Sansevieria guineensis*).

Timbers.—The local timbers are not used to any large extent.

Exhibits—

Sea Side Grape (*Coccoloba uvifera*). Crab Wood.

Miscellaneous Plant Products.—

Exhibits—

Purging Cassia. The pods of *Cassia Fistula*. The pulp surrounding the seeds is a mild laxative, and is used in the preparation of "Confection of Senna."

Job's Tears (*Coix Lachryma-Jobi*) } Ornamental Seeds.
Circassian Seeds (*Adenanthera pavonina*) } Ornamental Seeds.
Caconier Seeds (*Ormosia coccinea*) } Ornamental Seeds.

Maps and Photographs.

Grenada-Admiralty Chart, 1859.

Grenada and the Grenadines also appear in the Admiralty Chart, "Guadeloupe to Trinidad."

St. George's Harbour (Four Views).
Grand Etang (Four Views).
Lake Antoine (Two Views).
Antoine: Belle Vue.
St. Catherine's Peak.
Fedon's Camp.
Nutmeg Trees.
Tree Ferns.
View on the Chantilly stream.
Estate and general views.

ST. VINCENT.

St. Vincent lies between Grenada and St. Lucia, being 68 miles north-east of the former and 21 miles south-west of the latter. From Barbados it is distant 100 miles. The island, 18 miles in length and 11 miles in breadth, comprises an area of approximately 140 square miles. The small islands, the Grenadines, are situated between St. Vincent and Grenada and most of them belong to Grenada, but some, Bequia being the chief, are attached to St. Vincent for administrative purposes, and these bring the aggregate area of the Colony to 147 square miles.

St. Vincent is an island of volcanic formation, and like its neighbours has a ridge of well-wooded mountains running north and south. At the northern end of the ridge is the Soufrière, 3,520 feet, the scene of the disastrous eruptions of 1812 and 1902. The latter outbreak devastated the northern portion of the island and caused the deaths of over 2,000 people. Spurs from the central ridge run towards the coast, but, on the eastern side of the island in particular, there are areas of open, level country between the mountains and the sea. The level tract in the north-east between the Soufrière and the sea is called the Carib country. Cultivation is chiefly confined to these stretches and to the lower portions of the valleys. Kingstown Bay on the south-west coast is the chief inlet, and Kingstown the capital is situated here.

The climate is fairly equable; the rainfall being on the average about 100 inches and the mean temperature about 78° F. Unfortunately, unlike Grenada, the island is subject to occasional visits by hurricanes, and during recent years the storm of 1898 caused great damage to crops and buildings.

The principal products of St. Vincent are arrowroot, for many years the staple, but now surpassed in value by cotton. Sugar is cultivated only on a comparatively small scale. Cocoa is being grown to an increasing extent, and attention is also given to spices, principally nutmegs. Foodstuffs are grown for local consumption, and there is a considerable export trade with neighbouring islands in live stock, mostly sheep, goats and pigs. There is a small whaling industry in the Grenadines.

Vegetable Products.

Cotton.—Although the present industry was not established until 1903–04, cotton has already become the principal crop, the value of the export in 1908 amounting to over £33,000. Sea Island cotton is the variety cultivated, and St. Vincent cotton has earned a high reputation for the quality produced. The Imperial Department of Agriculture took a great part in developing the industry, and manages the central cotton ginnery; others have since been started by private enterprise.

Exhibits—

Sea Island Cotton, Seed Cotton and Seed from various estates.

Fibres.—There is no commercial production of fibre other than cotton. Native and introduced plants yield fibres, which are in some cases put to local uses.

Exhibits—

Coir from the Coco-nut (*Cocos nucifera*).
Coco-nut (*Cocos nucifera*), the fibrous sheathing bases of the leaves.
Gru-gru fibre (*Acrocomia lasiospatha*), ribbons and fishing-line prepared from the fibre.
Karata fibre and rope made from it—prepared from the leaves of *Bromelia Karatas*.
Manila hemp (*Musa textilis*).
Dagger fibre—extracted from the leaf of *Yucca aloefolia*.
Arrowroot fibre—the *débris* from preparation of arrowroot, washed. It has been suggested as a possible paper-making material.
China stem fibre, or Ramie (*Boehmeria nivea*).
Mahoe fibre and rope (*Paritium elatum*).
Cocoa ribbons—strips of bark of the cocoa tree (*Theobroma Cacao*).
Silk cotton fibre—the hairs which occur, lining the seed-pods of *Eriodendron anfractuosum*. It is usually classed as "Kapok."
Bois flot fibre—similar hairs from the pods of *Ochroma Lagopus*.

Arrowroot (*Maranta arundinacea*).—Arrowroot is grown, particularly in the more northern part of the island. It is an annual crop, the rhizomes being ready for digging about ten months after planting. They are then washed, rasped, and the starch separated from the other matter by repeated successive washings and settlings. Although the export of arrowroot is now of less value than cotton, arrowroot still occupies a greater area than any other crop.

Exhibits—

Arrowroot loose and in commercial packets.

Cassava.—The Cassava (*Manihot utilissima*) is grown for local use.

Exhibits—

Cassava Meal or Farina, and Cassava Starch.

Cocoa (*Theobroma Cacao*).—The tree thrives in St. Vincent, and its cultivation is increasing slowly, but the output suffered a severe set-back as a result of the hurricane of 1898.

Exhibits—Cocoa beans.

Coffee.—Coffee is grown on a small scale for local consumption.

Exhibits—

Arabian Coffee (*Coffea arabica*).
Sierra Leone Coffee (*C. stenophylla*).
Liberian Coffee (*C. liberica*).

Cola.—The West African Cola Tree (*Cola acuminata*) has been introduced and succeeds well. As in many other colonies it could be grown extensively were there a more remunerative market for the dried seeds.

Exhibits—Cola seeds or "nuts."

Spices.—Nutmegs are grown to a limited extent, and in former years both nutmegs and mace were exported. Many of the trees were destroyed in the hurricane of 1898, and the production is now very small.

Exhibits—

Nutmegs (*Myristica fragrans*), shelled and unshelled.
Mace—the dried arillus of the nutmeg.
Vanilla pods or beans (*Vanilla planifolia*).

Pigeon Peas (*Cajanus indicus*) are grown extensively as a foodstuff.

Exhibits—Pigeon Peas.

Sugar.—The sugar industry of St. Vincent has been subject to gradual decay since about 1882, when the export of sugar and allied products amounted to £114,000; in 1908 they were worth only £5,500. A moderate amount is made for local consumption.

Exhibits—Muscovado Sugar. White Rum.

Timbers.—The island is heavily wooded, but as is the case in several other West Indian Islands the lack of cheap transport—particularly by water—prevents the often valuable and useful native woods being worked to any considerable extent.

Exhibits—

Bread Fruit Tree (*Artocarpus incisa*).
Red Sandal Wood (*Adenanthera pavonina*).
Mammee apple (*Mammea americana*).
Guava (*Psidium Guajava*).
Java Plum (*Calyptranthes* sp.).
Logwood (*Hæmatoxylon campechianum*).
Nutmeg (*Myristica fragrans*).
Tamarind (*Tamarindus indica*).
Red Mastic (*Bursera gummifera*).
Poui (*Tecoma spectabilis*).
Bermuda Cedar (*Juniperus bermudiana*).
White Cedar (*Tecoma leucoxylon*).
Spanish Elm (*Cordia gerascanthoides*).
Seaside Grape (*Coccoloba uvifera*).
Fiddle wood (*Petitia domingensis*).
Mastic or Yellow Sanders (*Bucida capitata*).
Manchineel (*Hippomane Mancinella*).
Sweet wood (*Nectandra leucantha*).
Mountain Gommier (*Dacryodes hexandra*).
Bullet wood (*Mimusops globosa*).
Spanish Oak.
Cypress.

Resins and Gums.—These are collected on a small scale from forest trees, etc.

Exhibits—

Gommier Resin from the tree *Bursera gummifera*, sometimes known as the West Indian birch. It is used in the West Indies for making torches and for incense.

Tacamahaca resin or "Gum Animi," from *Protium* sp., very similar to the "Hyawa Gum" or "Incense gum" of British Guiana. The genus Protium (also known as Icica) is closely related to Bursera. This resin should not be confused with Zanzibar and Demerara "animis" which belong to the group of copals.

Golden apple gum (*Spondias dulcis*).

Cashew Nuts.—The seeds of *Anacardium occidentale*, a small tree native to the West Indies, and now grown throughout the tropics. Roasted, they are excellent dessert nuts.

Exhibits—Cashew nuts, in shell.

Annatto or Roucou (*Bixa Orellana*).—The seeds of this small tree have a pulpy exterior coating which yields the well-known dye annatto,, in limited demand as a colouring material for cheese, butter and other fatty substances.

Exhibits—Annatto seeds.

Musk Ochro (*Hibiscus Abelmoschus*).—The seeds of this bush have a well-marked musk odour, and are used to a moderate extent in sachets, etc.

Exhibits—Musk ochro seeds, also known as Gombo musk.

Basket-work.—Various specimens of native workmanship are exhibited.

Maps, Photographs, etc.

St. Vincent and the Northern Grenadines. Admiralty Chart. 1908.

Cotton Factory.

Cotton Factory, Interior—Gins at work.

Eruption of the Soufrière, 1902.	"Wallibu Valley"	Presented by Dr. Tempest Anderson.
" " "	"Lot 14"	

ST. LUCIA.

St. Lucia, the most northerly of the group of the Windward Islands, lies about 21 miles north-east of St. Vincent and about 90 miles W.N.W. of Barbados. It is the largest of the Windward Islands, being some 233 square miles in area; its greatest length is 24 miles, and breadth 12 miles.

The island is of volcanic origin and very rugged. A mountainous

ridge runs more or less north and south, and subsidiary ridges and spurs run to the coast on all sides. The highest point is Morne Gimie, 3,145 feet. Plains and broad valleys are rare. The largest plains are those of Vieux Fort in the south-east and Gros Islet in the north-west. The principal valleys are Roseau and Mabouya, on the west and east respectively. Narrow valleys running down to the sea from the central mountainous masses are predominant. Down these valleys run small rivers, which, becoming torrents in the wet season, often do great damage to plantations, roads, etc.

The coast of the island is deeply indented, and there are many good and safe bays, especially on the leeward or western side. By far the most important is Castries Bay, which affords good anchorage and coaling facilities, having one wharf 650 feet in length with a depth alongside of 27 feet at low water, and another 552 feet with 18 to 24 feet of water alongside. Castries, the principal town, is situated around this bay and on the lower slopes of the steep encircling hills.

The climatic conditions are those characteristic of the damp tropics: a mean annual temperature of about 78° F. and a rainfall of 100 inches. The principal products of St. Lucia are sugar with rum, etc., and cocoa, which constitute the bulk of the exports. Recently Central American rubber trees (*Castilloa elastica*) having attained sufficient age to be tapped have been found to yield rubber of good quality and a small quantity has been exported. Logwood was formerly an important export but is so no longer, the exports being valued in 1907 at less than £1,000, whereas as recently as 1894 they were over £37,000. There are many small exports, and lime cultivation promises to be successful.

Vegetable Products.

Sugar.—The sugar cane (*Saccharum officinarum*) is largely cultivated in St. Lucia. The factories (usines) manufacture crystal sugars of the type known as Demerara sugar. Only a very small amount of muscovado sugar (prepared in open boiling pans) is exported; a by-product is molascuit, a cattle food consisting of the finer portions of the crushed cane (megass) saturated with molasses. The value of sugar products exported in 1908 was about £55,000.

Exhibits—

Yellow Crystal Sugar } Prepared in vacuum pans.
White Crystal Sugar }

Molasses Sugar, prepared from the molasses left from a former batch of sugar.

White Rum, as distilled.

Coloured Rum, as usually prepared for sale by addition of a small quantity of caramel.

Cocoa (*Theobroma Cacao*).—St. Lucia is well adapted to cocoa cultivation. The mountainous character of much of the island affording

situations better suited to this plant than to cotton, sugar, etc. The industry is largely in the hands of peasant proprietors. The crop fluctuates considerably, but on the whole has made marked progress during recent years.

Exhibits—Cocoa beans.

Coffee.—Arabian coffee (*Coffea arabica*), and Liberian coffee (*C. liberica*) are grown on a small scale for local use. There is very little likelihood of their cultivation increasing considerably.

Exhibits—Arabian coffee.
Liberian coffee.
Mocha coffee.

Cotton.—During recent years it has been demonstrated that Sea Island cotton of good quality can be produced with proper care, and although St. Lucia has not taken a prominent part in the revival of the West Indian cotton industry, the cultivation is being considerably extended. It is, however, scarcely likely to become very important, the island being better suited to crops such as cocoa and rubber.

Exhibits—Upland cotton, bolls.
Native cotton, coton du pays, a wild cotton.

Fibres.—Specimens of fibres from native plants, or from plants experimentally introduced, have been prepared. They are not, however, of commercial importance.

Exhibits—

Manila Hemp (*Musa textilis*).
Figue Carata Fibre (*Musa sapientum*).
Figue Carata rope.
Figue giouboute (*Musa sapientum*).
Langue de Bœuf Fibre (*Fourcroya cubensis*).
Lapitre Fibre (*Agave* sp.).
Mahout Fibre (*Heliocarpus americana*).
Coir from the Coco-nut (*Cocos nucifera*).

Rubber.—The Central American Rubber tree (*Castilloa elastica*) is thriving in St. Lucia, and specimens of the rubber have been favourably reported upon as being of good quality, strong, well prepared, and capable, with slight improvement, of comparing well with any Castilloa rubber on the market. The first (small) export of rubber was made in 1906.

Exhibits—

Castilloa elastica—Botanical specimen, Fruits and Seeds. Biscuit rubber valued (1908) at 3*s.* 6*d.* per lb., with fine hard Para at 4*s.* 3½*d.* per lb., also Scrap rubber.

Rice (*Oryza sativa*).—As not infrequently is the case in tropical countries where East Indian labour is imported, the coolies in St.

Lucia have taken up rice cultivation. The production is not, however sufficient to meet the local demand.

Exhibits—Husked Rice.

Spices.—Various spice-bearing plants are grown on a small scale.

Exhibits—

Nutmegs, shelled and unshelled.
Mace, the dried arillus of the nutmeg.
Cloves.
Pepper.

Gums and Resins.

Exhibits—

Cashew "Gum" (*Anacardium occidentale*).
Gommier Resin (*Bursera gummifera* [probably]).
Incense Resin (*Dacryodes hexandra* [probably]).

Castor Oil Beans (*Ricinus communis*) grown throughout the tropics.

Mineral Products.

Jasper.—An impure, opaque variety of silica or quartz, commonly brown, red or yellow in colour. Some jaspers are very ornamental.

Exhibit—Block of rough jasper.

Map.

St. Lucia Admiralty Chart, 1888.

BULLETIN

OF THE

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SCIENTIFIC AND TECHNICAL DEPARTMENT.

RECENT INVESTIGATIONS.

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Colonial and Indian Governments concerned.

WHEATS FROM AFRICAN COLONIES AND INDIA.

SAMPLES of wheat have been received recently at the Imperial Institute for examination from various Protectorates in Africa and from India. In the East Africa Protectorate particularly, much attention is now being given to the cultivation of wheat, and already local requirements are being largely met, and it seems likely that in the near future considerable quantities may become available for export to the United Kingdom from this source. The following reports show that grain of fine quality can be grown in that Protectorate, and that wheats of very promising character can be produced in Uganda and Northern Nigeria.

WHEATS FROM THE EAST AFRICA PROTECTORATE.

Two samples of wheat were supplied to the Imperial Institute in June 1909, by the Director of Agriculture. They were stated

WHEAT FROM UGANDA.

This wheat was received for examination from the officer-in-charge of the Botanical, Forestry and Scientific Department at Entebbe in April 1909. It was stated to consist of wheat grown in Toro, Uganda.

The grains were large and of fairly uniform size, but a few flattened and small grains, and a few unusually large grains, were also present. The few small grains consisted almost entirely of soft wheat, but the remainder was all of the "durum" type, and the grains when cut across showed the characteristic translucence of that variety. The sample was clean.

Results of Examination.

The wheat gave the following results on analysis, compared with the figures recorded for typical American "durum" wheats:—

	Present sample. *Per cent.*	Macaroni wheat from Dakota. *Per cent.*	Average American grown "durum." *Per cent.*
Total protein . .	13·04	15·19	14·0
Crude gluten . .	12·04	14·10	11·7
Gliadin	5·53	not quoted	6·0

The Uganda wheat is thus a little poorer in protein than the two "durum" wheats from the U.S.A., of which analyses are quoted above.

Commercial Valuation.

The wheat was submitted to commercial experts, who reported that it was worth about 35*s.* per quarter of 480 lb. c.i.f. London (October 1909). It was stated to be suitable for Continental markets, where it should sell at prices fully equal to those obtained for American "durum" wheats.

WHEATS FROM NORTHERN NIGERIA.

These were forwarded to the Imperial Institute by the Inspector of Agriculture for West Africa in August 1909. The samples were as follows:—

No. 1. *Wheat from Kano, Northern Nigeria.*—Medium-sized

wheat, partly "hard" and partly "soft," the "soft" portion being about one-third of the whole.

No. 2. *Wheat from Zaria, Northern Nigeria.*—The following information was supplied regarding this wheat:—

> "Planted end of rains (October?) irrigated, manured with goat litter and sweepings, and in 2 to 2½ months is ready for harvesting. Beaten out in a mortar. Not much grown; only eaten by richer people. Retail price, 1½*d.* per lb."

It consisted of rather small, dull, darkish grains, in good condition. A few pieces of stalk, some immature grains and a few foreign seeds were present, but the sample was on the whole clean. The bulk of the wheat was "hard," but a few "soft" grains were observed.

Results of Examination.

The samples were analysed and gave the following results, which may be compared with the corresponding figures for average "North Western spring wheat" from the United States:—

	No. 1. Wheat from Kano. *Per cent.*	No. 2. Wheat from Zaria. *Per cent.*	U.S.A. "North Western Spring wheat." *Per cent.*
Gluten . .	11·3	10·7	9·9
Gliadin . .	5·9	6·3	5·0

Commercial Valuation.

The samples were submitted to a firm of grain merchants in London, who reported that No. 1 from Kano was a description of wheat that would need very careful testing before an actual valuation could be given, but that they estimated the value at about 36*s.* 6*d.* per 480 lb. c.i.f. London (October 1909). They stated that No. 2, from Zaria, was of very good character, and would be worth about 37*s.* 6*d.* per 480 lb. c.i.f. London (October 1909).

The firm added that it is impossible to give exact valuations of such wheats as the present samples until they have been tested by actual milling and baking trials. They appeared, however, to consider that such grain would find a large market in Europe.

As the quantity of Kano wheat was sufficiently large for practical trials, a sample was submitted to Mr. A. E. Humphries, who, as the result of milling and baking experiments, reported that it would find a ready sale in the United Kingdom, and that in quality it is not far behind "Gluyas." (See above.)

MACARONI WHEAT FROM SIND, INDIA.

This sample of macaroni wheat was forwarded to the Imperial Institute with the request that its value for making macaroni might be ascertained with a view to its export to Italy, as at present this wheat is not touched by exporters in India for the English trade.

The sample was described as a strong hardy wheat growing well in "kalarish" ground, and having considerable rust-resisting powers. It was stated to be a typical macaroni wheat, containing much gluten.

Chemical Examination.

The wheat was examined chemically to determine the proportion of gluten present, with the following results:—

	Sample as received. *Per cent.*	Gluten in dry wheat. *Per cent.*
Gluten . .	11·70	13·46
Moisture . .	13·10	—

The gluten was of good quality, fairly elastic, and not too dark in colour.

The amount of gluten in American macaroni wheats usually varies from 12·5 to 17·9 per cent. in the dry wheat, and occasionally rises to as much as 20 per cent.

Commercial Valuation.

Samples of the wheat were forwarded to firms of macaroni manufacturers in France, Italy and Sicily for examination. The Sicilian firm stated that this Indian wheat may be considered suitable for making macaroni, but they pointed out that when large quantities of wheat of this quality were imported into Sicily it was found to answer the purpose better if mixed with hard Taganrog wheats, in the proportion of one-third of the latter.

A firm in Naples reported that this wheat was perfectly suitable for making macaroni, and stated that they would like to receive offers of consignments.

With reference to the prices of macaroni wheat in Europe it is stated that the only hard wheat at present imported into Naples for the manufacture of macaroni is Russian, which is sold at the average price of 22·75 lire per 100 kilos (equivalent to 9*s.* 3*d.* per cwt.) c.i.f. in bulk, cash against documents, 1 per cent. discount. Of Indian hard wheat, only small lots have been sold of "Hard Red" "70 per cent." at 22⅝ lire per 100 kilos (9*s.* 1½*d.* per cwt.) c.i.f. in bags, gross for net cash against documents, 1 per cent. discount. There is also a commission of 1 per cent. from seller to agent, to which the above prices are subject. The great difficulty in the importation of Indian wheat is the time of shipment. Shipments should be made to Italy before the 15th May by direct steamers, as otherwise the wheat would come in when the new crop was ready.

SUNN HEMP FROM INDIA.

TEN samples of "sunn" or "san" hemp (*Crotalaria juncea*) from India were examined recently. They had been grown in the Pabna District of Eastern Bengal and Assam, where the following method of preparation is practised.

The plants are either pulled or cut, and are then immediately retted, without being previously dried, by immersion in water; running river water is preferred to stagnant pool water for this purpose, since it furnishes a fibre of better colour, strength and softness. Considerable care is required to stop the retting at the right point, as over-retting renders the fibres weak and brittle, whilst under-retting leaves the product in an unsatisfactory state, with portions of bark adhering to it. It is stated that the cultivators consider that the "Phulsan," or flower-bearing san plant, yields a better quality of fibre than the seed-bearing plant.

An account of the cultivation and preparation of Sunn hemp in the Pabna District, is given in a recent *Agricultural Ledger* (No. 7 of 1908–09) which includes the results of the present

investigation. The area devoted to this crop in the Pabna District is almost entirely situated in the Serajganj Sub-division and amounts to about 27,000 acres. The total annual production of the fibre is estimated to be about 5,000 tons.

The ten samples of fibre received at the Imperial Institute are described in the following paragraphs. The opinion of experts on the commercial value of these fibres and the results of the chemical examination of three of the specimens are recorded.

No. 1, *from Talgachi, Pabna District.*—The fibre was straw-coloured and of fair lustre, fairly well cleaned, but somewhat towy at the ends and containing some adherent tissue. It was of fairly good strength, and 7 feet long, and was regarded by commercial experts as worth £25 per ton (May 1909). With reference to this and the nine following samples, the brokers reported that the prices quoted as the current value of the fibres might be regarded as fully £4 per ton above their normal value, owing to a shortage in the supply.

No. 2, *from Talgachi, Pabna District.*—This fibre was mostly grey but partly greenish, and was of poor lustre. It was not very well cleaned, but contained a considerable quantity of woody and other matter. The strength was fairly good, and the length amounted to about 4 feet. The product was valued at £18 per ton (May 1909).

No. 3, *from Talgachi, Pabna District.*—The fibre was of very pale straw-colour, and of fair lustre. It was fairly well cleaned, was of fairly good strength, and 6 feet long.

On chemical examination it yielded the following results:—

	Per cent.
Moisture	8·0
Ash	0·3
α-Hydrolysis (loss)	7·5
β-Hydrolysis (loss)	16·0
Acid purification (loss)	1·0
Cellulose	87·9

Fibre of this quality was regarded as worth £25 per ton (May 1909).

In chemical composition and behaviour this sample compared

favourably with the samples of Sunn hemp previously examined at the Imperial Institute (compare table on p. 125).

No. 1, *from Ullapara, Pabna District.*—This was a very pale straw-coloured fibre, of fair lustre and slightly green in parts. It was fairly well cleaned, but contained some particles of adherent tissue, which were easily removed by gentle hackling. The strength was good, but rather uneven, and the length of staple was about 6 feet. The fibre was valued at £25 per ton (May 1909).

No. 2, *from Ullapara, Pabna District.*—This fibre was of very pale straw-colour and of fair lustre. It was fairly well cleaned, but contained some adherent tissue, which was easily removed on hackling. The product was of good but rather uneven strength, and 5 feet 9 inches long.

On chemical examination the following results were obtained:—

	Per cent.
Moisture	8·3
Ash	0·3
α-Hydrolysis (loss)	6·3
β-Hydrolysis (loss)	15·7
Acid purification (loss)	1·0
Cellulose	88·8

The material was regarded as worth £24 per ton (May 1909). This fibre closely resembled No. 3 from Talgachi in chemical composition and behaviour.

No. 3, *from Ullapara, Pabna District.*—This was a pale straw-coloured fibre, slightly darker than sample No. 2 from Ullapara. It was fairly well cleaned, but contained some adherent tissue, which could be easily removed by hackling. The product was of good but rather uneven strength, and 6 feet 6 inches long, and was valued at £23 per ton (May 1909).

No. 1, *from Kaijuri, Pabna District.*—This sample consisted of very pale straw-coloured fibre of fair lustre. It was well cleaned and contained less extraneous matter than the other samples. The strength was fairly good, and the length was about 5 feet 6 inches.

The results of the chemical examination were as follows:—

	Per cent.
Moisture	8·2
Ash	0·3
a-Hydrolysis (loss)	6·7
β-Hydrolysis (loss)	15·7
Acid purification (loss)	1·4
Cellulose	87·6

Fibre of this quality was considered to be worth £27 per ton (May 1909).

In chemical composition and behaviour, this sample closely resembled No. 3 from Talgachi and No. 2 from Ullapara.

No. 2, from Kaijuri, Pabna District.—This sample consisted of straw-coloured fibre, of fair lustre, and fairly well cleaned, but somewhat gummy and containing some woody fragments. It was of fairly good strength, 6 feet 6 inches long, and was valued at £25 per ton (May 1909).

No. 3, from Kaijuri, Pabna District.—This fibre was buff-coloured and of fair lustre. It was not well cleaned, but contained a large amount of woody and other extraneous matter. The strength was fair, the length averaged 5 feet 3 inches, and the value was estimated at £20 per ton (May 1909).

No. 4, from Kaijuri, Pabna District.—This fibre was grey and lacking in lustre. It was not well cleaned, but contained a large quantity of woody matter and tow. The material was rather weak, 4 feet to 5 feet long, and was valued at £17 per ton (May 1909).

CONCLUSIONS.

The commercial experts to whom the samples were submitted confirmed the conclusions, deduced from the results of the chemical examination, that these fibres were of remarkably good quality. They were also particularly satisfactory in respect of length, strength and colour, and would find a ready market. Several of them were above the average length and were very well prepared.

It may be of interest to compare the results of the chemical examination in the present instance with the figures obtained

for specimens of Burmese and Calcutta Sunn hemp previously examined at the Imperial Institute.

	No. 3. from Talgachi.	No. 2. from Ullapara.	No. 1. from Kaijuri.	Burmese Sunn Hemp.	Calcutta Sunn Hemp.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	8·0	8·3	8·2	9·8	9·4
Ash	0·3	0·3	0·3	3·1	0·6
α-Hydrolysis (loss)	7·5	6·3	6·7	9·2	10·5
β-Hydrolysis (loss)	16·0	15·7	15·7	15·8	14·0
Acid purification (loss)	1·0	1·0	1·4	3·7	1·6
Cellulose	87·9	88·8	87·6	87·5	90·8

This comparison indicates that the three samples from Eastern Bengal and Assam were of very good quality, and closely resembled those received from Burma and Calcutta. The former samples, however, probably contained smaller amounts of soluble extraneous impurity than the latter since they suffered smaller loss on α-hydrolysis and acid purification.

The results of this investigation show that the Sunn hemp of the Pabna District is of a quality which would find a ready sale at good prices in the United Kingdom. The cultivation of this crop can therefore be safely extended.

RUBBERS FROM THE WEST INDIES.

THE following reports give the results of the examination at the Imperial Institute of samples of Castilloa and Para rubber from Tobago, St. Lucia and Dominica.

CASTILLOA RUBBER FROM TOBAGO.

The specimen was a large square sheet of *Castilloa elastica* rubber about ⅛ inch thick and weighing 2½ lb. The rubber was black, clean, and well prepared; its physical properties were very satisfactory.

It had the following composition:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	1·0	—
Caoutchouc	91·1	92·0
Resin	6·1	6·2
Proteids	0·8	0·8
Insoluble matter	1·0	1·0
Ash	2·20	2·22

The sample was valued at 4*s.* 4*d.* per lb. in London, with fine hard Para from South America quoted at 5*s.* per lb. This rubber is of good quality, and would be readily saleable.

CASTILLOA RUBBER FROM ST. LUCIA.

This sample, which was labelled "Small slab of biscuit rubber, *Castilloa elastica*," weighed 3 oz. It consisted of a small cake of rubber about 6 inches long, 3 to 4 inches wide and ¼ inch thick. The rubber was almost black, but was clean and well prepared; its physical properties were very satisfactory.

An analysis gave the following results:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	0·3	—
Caoutchouc	88·6	88·9
Resin	9·1	9·1
Proteids	1·3	1·3
Insoluble matter	0·7	0·7
Ash	0·46	0·46

The sample was valued at about 3*s.* 6*d.* per lb. in London, with fine hard Para from South America quoted at 4*s.* 3½*d.* per lb.

The analytical results show that this Castilloa rubber from St. Lucia is of good quality, although the percentage of resin is a little high. This slight defect may possibly disappear as the trees become older. Consignments of similar character to the present sample would be readily saleable.

CASTILLOA RUBBER FROM DOMINICA.

The specimen, which was labelled "Large biscuit of *Castilloa elastica*," weighed 1 lb. 2 oz. It consisted of a large rough

biscuit of black rubber, about 11 inches in diameter and $\frac{3}{8}$ inch thick. The rubber was clean, dry and well prepared; its physical properties were very satisfactory.

The results of the analysis were as follows:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	1·9	—
Caoutchouc	84·0	85·6
Resin	9·2	9·4
Proteids	3·7	3·8
Insoluble matter	1·2	1·2
Ash	2·09	2·13

The sample was valued at about 3*s.* 6*d.* per lb. in London, with fine hard Para from South America quoted at 4*s.* 3½*d.* per lb.

The results of the analysis show that this rubber is of good quality, though the percentages of resin and proteid are a little high.

PARA RUBBER FROM DOMINICA.

The sample was labelled "Small Biscuits of Para Rubber," and weighed 5 oz. It consisted of three biscuits of rubber about 6 inches in diameter and $\frac{1}{16}$ to $\frac{1}{8}$ inch thick. The rubber was light-coloured, clean and well prepared; it exhibited good elasticity and tenacity.

An analysis gave the following results:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	0·4	—
Caoutchouc	93·0	93·4
Resin	4·2	4·2
Proteids	2·1	2·1
Ash	0·3	0·3

The sample was valued at 4*s.* 3*d.* per lb. in London, with fine hard Para from South America quoted at 4*s.* 3½*d.* per lb., and plantation Para biscuits at 4*s.* 4*d.* to 4*s.* [illegible]*d.* per lb.

This rubber is of very good quality, and compares favourably in composition with plantation Para rubber from Ceylon and

the Federated Malay States. There is no doubt that the Para tree will furnish excellent rubber in Dominica.

CEARÁ RUBBER FROM NYASALAND.

THIS sample of Ceará rubber weighed $7\frac{1}{2}$ oz., and consisted of five biscuits of pale rubber, which was clean and well-prepared. The rubber exhibited very good elasticity and tenacity.

An analysis gave the following results:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	1·2	—
Caoutchouc	85·1	86·1
Resin	6·7	6·8
Proteids	6·1	6·2
Ash	0·9	0·9

The sample was submitted to brokers, who valued it at 5*s.* 4*d.* per lb. in London, with fine hard Para from South America at 5*s.* 4*d.* per lb., and fine plantation Para biscuits at 5*s.* $4\frac{3}{4}$*d.* to 5*s.* $5\frac{3}{4}$*d.* per lb.

The results of the analysis show that this rubber is of satisfactory composition, although the percentages of resin and proteid are higher than those recorded for some specimens of Ceará rubber from Ceylon. The sample compares very favourably both in appearance and composition with specimens of Ceará rubber from Portuguese East Africa which have been examined at the Imperial Institute (see this *Bulletin*, 1908, 6. 255).

The rubber contained a quantity of the so-called insoluble caoutchouc, which was white and very tenacious when dry.

Consignments of similar character to this sample would always be readily saleable at good prices.

GENERAL NOTICES RESPECTING ECONOMIC PRODUCTS AND THEIR DEVELOPMENT.

INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE AND COLONIAL DEVELOPMENT.

BRUSSELS: MAY 1910.

A PRELIMINARY announcement of this Congress was published in this *Bulletin* (1909, 7. 409), in which its origin, organisation and scope were described. The Congress was held at the Palais de Congrès of the Brussels Exhibition from May 20th to 23rd last, and was largely attended by British, German, French, Belgian, Russian and other representatives, and many interesting reports and papers were presented to it and discussed. At the suggestion of the International Association of Tropical Agriculture and Colonial Development, a British Committee was formed in May last to arrange for the contribution of papers by British representatives, and this committee was finally constituted as follows:—

PRESIDENT: Prof. Wyndham Dunstan, M.A., LL.D., F.R.S., *Director of the Imperial Institute.*

MEMBERS: Mr. F. Beadon-Bryant, *Inspector-General of Forests to the Government of India;* Mr. H. Brown, *Technical Superintendent, Scientific and Technical Department, Imperial Institute;* Professor P. Carmody, F.I.C., *Director of the Department of Agriculture, Trinidad;* Mr. J. B. Carruthers, *Assistant Director of Agriculture, Trinidad;* Dr. C. W. Daniels, *Director of the London School of Tropical Medicine;* Mr. M. T. Dawe, *Officer-in-Charge, Botanical, Forestry and Scientific Department, Uganda;* Mr. G. C. Dudgeon, *Inspector of Agriculture for British West Africa;* Mr. I. B. Pole Evans, *Plant Pathologist, Department of Agriculture, Transvaal;* Dr. E. Goulding, F.I.C., *Principal Assistant, Scientific and Technical Department, Imperial Institute;* Professor J. B. Harrison, C.M.G., M.A., F.I.C., *Director of the Science and Agriculture Department, British Guiana;* Mr. J. M. Hillier, *Curator of Museums, Royal Gardens, Kew;* Mr. A. E. Humphries; Mr. E. M. Jarvis, M.R.C.V.S., *Government Veterinary Surgeon, Department of Agriculture, Rhodesia;* Mr. M. Kelway-Bamber, F.I.C., *Government Chemist, Ceylon;* Mr. R. N. Lyne, *Director of Agriculture, Zanzibar;* Lt.-Colonel D. Prain, C.I.E., M.A., M.B., LL.D., F.R.S., *Director of the Royal Botanic Gardens, Kew;* Mr. J. S. J. McCall, *Director of Agriculture, Nyasaland;* Mr. A. C. Macdonald, *Director of Agriculture, East Africa Protectorate;* Mr. J. H. Maiden, F.L.S., *Director of the Botanic Gardens, Sydney,*

New South Wales; Professor W. Roberts, B.Sc., *Punjab Agricultural College, India;* Mr. F. B. Smith, *Director of Agriculture, Transvaal;* Mr. S. Stockman, *Chief Veterinary Officer of the Board of Agriculture and Fisheries, London;* The Hon. Dr. Watts, C.M.G., D.Sc., F.I.C., *Imperial Commissioner for Agriculture in the West Indies;* Dr. J. C. Willis, M.A., *Director, Royal Botanic Gardens, Ceylon.*

SECRETARY: Dr. T. A. Henry, *Superintendent of Laboratories, Scientific and Technical Department, Imperial Institute.*

The opening meeting of the Congress coincided with the funeral of the late King Edward, and consequently the President, Colonel Thys, merely declared the Congress open and adjourned the meeting as a mark of respect to the memory of His late Majesty.

The work of the Congress was divided among three sections, No. 1 dealing with General Agriculture and Forestry, No. 2 with Rural Industries and the Breeding of Stock, and No. 3 with Transport, Trade and Commerce. Sectional meetings were held on the 21st, 22nd and 23rd May. The following is a brief résumé of the proceedings of the various sections, with summaries of the British reports and papers communicated.

SECTION I.—GENERAL AGRICULTURE AND FORESTRY.

In July 1909 the International Association of Tropical Agriculture and Colonial Development selected a number of subjects connected with tropical agriculture for special investigation and inquiry, and a general reporter was appointed for each of these, charged with the duty of obtaining a special report on the subject concerned, from a recognised authority in each country interested, and with the preparation of a general report for presentation to the Congress.

It will be convenient to summarise first the general and special reports presented in connection with these various inquiries.

General Report on the Present Position of Cotton Cultivation.

By Prof. WYNDHAM DUNSTAN, M.A., LL.D., F.R.S.

In his General Report, Professor Dunstan, after drawing attention to the dependence of European cotton manufacturers on the United States and Egypt for their raw material, and recalling the various factors which tend to produce irregularity in the supply and market price, referred to the possibility of obtaining large supplies from other countries. The

prospects of the West African Colonies and Protectorates of the United Kingdom, France, Germany and Belgium were considered, and the question of extending cotton-growing in these countries was discussed. The natives of these regions must be left to decide as to the crops which are most profitable for them to grow, and, in some localities, cannot under existing circumstances be persuaded to cultivate cotton. It is most important that active Agricultural Departments should be created which can conduct experiments in the improvement of cotton and afford demonstrations to the natives. Much can also be effected by organisations, such as the British Cotton Growing Association, in providing ginning facilities, establishing buying agencies, and affording other practical assistance in the development of the industry.

The chief scientific problem to be solved in West Africa is the establishment of a type of cotton suited to the country and of the quality required by European spinners. In order to secure this, systematic experiments are required, and such work can be best conducted by a Government Department. It is often the case that there is already an indigenous cotton in existence in a country, which by systematic hybridisation can be so improved as to yield a fibre of greater length and superior quality. Accounts of such work are given in the special reports from the United States, West Africa, British Guiana and Egypt. The systematic selection of seed for sowing has given good results in many countries, and is now being regularly practised in Egypt and elsewhere. In Uganda and Nyasaland acclimatised types of long-stapled American Upland cottons are gradually being evolved as the established cotton of these countries. In the West Indies the great success, which has attended the re-introduction of Sea Island cotton is largely due to the efforts of a Government Department working in co-operation with the British Cotton Growing Association.

In India the cultivation is almost entirely in the hands of the natives, who grow coarse, short-stapled cottons, which are thoroughly established and meet with a steady demand. The cultivator is therefore disinclined to grow a different class of cotton unless he is assured of a satisfactory crop and a greater profit. Progress in improving the Indian staple must necessarily be slow, and can be best achieved by systematic work on the part of the Agricultural Departments. A considerable amount of work in this direction has already been accomplished. It is possible, however, that the cultivation of better and longer-stapled varieties may be accelerated by a decline in the demand for short-stapled Indian cotton by Japan. Both Japan and China produce large quantities of coarse, short-stapled cotton, and if the cultivation should undergo a great extension in these countries, the demand for short-stapled Indian cotton would naturally decrease.

The importance of entomology in its application to cotton cultivation is recognised by all the more important countries of production. The Report for the United States shows the value of the entomological work

carried out by the Department of Agriculture, and especially in connection with the measures adopted to control the ravages of the boll-weevil and the cotton boll-worm. The risk of the boll-weevil being introduced into Africa in American seed is very remote, since it is improbable that the pest in any form could survive the journey. Considerable progress has been made in the United States in reducing the damage caused by this pest by cultivating early-maturing varieties of cotton. Entomological research has also demonstrated that the cotton boll-worm can be kept in check by the adoption of certain measures at the critical stages of its existence. The science of mycology is also of great importance, and has been applied in the United States to the study of various fungoid diseases of the cotton plant with excellent results, which may be illustrated by reference to the production of a strain of plants resistant to the wilt-disease.

The question of manures is also best studied by a Government Department, and much has been achieved in this direction by the United States Department of Agriculture. Unless due precautions are taken and the effect of manures ascertained by preliminary trials before applying them on a large scale, the growth of the plant may be stimulated in undesirable ways.

The experience of the United States and Egypt in cotton growing forms a valuable guide in deciding on the steps to be taken in introducing the cultivation into a new country. In the United States, the Department of Agriculture has conferred great benefit on the industry by the issue of its valuable Bulletins, and also by its well-organised efforts to improve the varieties grown and to combat the attack of insect and fungoid pests. The area under cultivation in the United States is capable of considerable extension, but whether such extension will take place must depend chiefly on the inclination of the farmer to grow cotton and the extent to which cheap labour is available.

The outlook in Egypt cannot be regarded as satisfactory, since, during recent years, a serious decline has taken place both in the quantity and quality of the crop. The precise reasons for this decline are not now easily ascertained. There has been no Government Department of Agriculture in Egypt to study the problems connected with the industry, although excellent work has been carried out recently by the Khedivial Agricultural Society. Among the various causes to which the decline has been attributed may be mentioned the ravages of the cotton worm and cotton boll-worm, the neglect of systematic seed-selection, and the exhaustion of the soil produced by cotton being grown in a two years', instead of a three years', rotation. Other probable causes are over-watering by the cultivators and the rise of sub-soil water owing to the system of irrigation as well as to deficient drainage. The whole question is now being investigated by a Commission to which the officers of the Agricultural Society are attached. There is great need for a thoroughly equipped Agricultural Department in Egypt modelled

on the lines of that of the United States, and provided with a staff of highly qualified officers.

Summaries were then given of the following special reports obtained by the General-Reporter from the countries named. In preparing these special reports the authors were asked to devote attention more particularly to the following points:—(1) The present position and prospects of the industry; (2) any special difficulties met with; and (3) nature of experimental work in progress. The names of the authors are given in italics:—UNITED STATES, *Department of Agriculture* (forwarded by James Wilson, Secretary); EGYPT, *W. Lawrence Balls*, M.A., Khedivial Agricultural Society; ANGLO-EGYPTIAN SUDAN, *Ernest Goulding*, D.Sc., Imperial Institute, London; INDIA, *G. A. Gammie*, F.L.S., Cotton Specialist to the Imperial Department of Agriculture; CYPRUS, *Wyndham Dunstan*, M.A., LL.D., F.R.S., Director of the Imperial Institute; MALTA, *F. Debour*, M.D., Inspector of Agriculture; UGANDA, *P. H. Lamb*, Acting-Superintendent, Cotton Department; EAST AFRICA PROTECTORATE, *A. C. MacDonald*, Director of Agriculture; NYASALAND, *J. Stewart J. McCall*, Director of Agriculture; NORTH-EASTERN and NORTH-WESTERN RHODESIA, *The British South Africa Company* (forwarded by E. H. Smith Wright, Acting Assistant Secretary); SOUTHERN RHODESIA, *Eric A. Nobbs*, Director of Agriculture; TRANSVAAL, *W. H. Scherffius*, Department of Agriculture; NATAL, *E. R. Sawer*, Director of the Division of Agriculture and Forestry; CAPE COLONY, *R. W. Thornton*, Department of Agriculture; GAMBIA, *Ernest Goulding*, D.Sc., Imperial Institute; GOLD COAST, *W. S. D. Tudhope*, Director of Agriculture; SIERRA LEONE, SOUTHERN NIGERIA and NORTHERN NIGERIA, *G. C. Dudgeon*, Inspector of Agriculture for British West Africa; MAURITIUS, *P. E. Bonamé*, Director of the Agricultural Station; SEYCHELLES, *P. R. Dupont*, Curator of the Botanic Station; QUEENSLAND and PAPUA, *Ernest G. E. Scriven*, Under-Secretary, Department of Agriculture and Stock; WEST INDIES, *Imperial Department of Agriculture for the West Indies* (forwarded by the Hon. Dr Watts, C.M G., D.Sc.); BRITISH GUIANA, *J. B. Harrison*, C.M.G., M.A., Director, Science and Agriculture Department; GERMAN COLONIES, *O. Warburg*, of the German Colonial Economic Committee; PORTUGUESE COLONIES, *H. P. Taveira*, of the Portuguese Industrial Association; RUSSIAN EMPIRE, *Boris de Fedtschenko*, of the Imperial Botanic Garden, St. Petersburg; ASIA MINOR, *Wyndham Dunstan*, M.A., LL.D., F.R.S., Director of the Imperial Institute, London; CHINA, *W. P. Ker*, Commercial Attaché, British Legation, Peking; DUTCH EAST INDIES, *J. Lovink*, Director of the Department of Agriculture; BELGIAN CONGO, *Belgian Ministry for the Colonies* (forwarded by the Deputy Director-General); INDO-CHINA, *G. Capus*, Director-General of Agriculture; TUNIS, *H. Rouppert*, Director of Agriculture; PERU, *Gerardo Klinge*, Director of the Experimental Cotton Station; BRAZIL, *Department of Economic Expansion*.

Two papers on special aspects of cotton cultivation were also communicated, of which the following are summaries:—

The Cottons in Indigenous Cultivation in British West Africa. BY G. C. DUDGEON, *Inspector of Agriculture for British West Africa.*—An account is given of the occurrence and distribution of the various species of cotton cultivated by the natives of British West Africa, the nomenclature and classification employed being based on those adopted by Sir George Watt in *The Wild and Cultivated Cotton Plants of the World.*

West African forms of the following cottons are described:—(1) *Gossypium arboreum*, Linn., var. *sanguinea*, Watt; (2) *G. obtusifolium*, Roxb., var. *africana*, Watt; (3) *G. punctatum*, Sch. and Thon., var. *nigeria*, Watt; (4) *G. hirsutum*, Linn; (5) *G. peruvianum*, Cav; (6) *G. mexicanum*, Tod.; (7) *G. purpurascens*, Poir.; (8) *G. vitifolium*, Lank.; (9) *G. barbadense*, Linn.); (10) *G. brasiliense*, Macf.

Application of Mendel's Law to Cotton Breeding. BY W. L. BALLS, M.A., *Botanist to the Khedivial Agricultural Society, Cairo.*—After a preliminary discussion of the Mendelian principles of heredity, an indication is given of the errors liable to be introduced in practice and the best means of overcoming them. The subject is illustrated by reference to the hybridisation of white American Upland with brown Egyptian cotton. The first generation resulting from this cross bears cream-coloured Egyptian lint. In the second generation there are on the average among 16 individuals, 4 brown-, 8 cream- and 4 white-linted plants. The four brown-linted plants consist on the average of 1 American Upland and 3 Egyptian. One of the Egyptian plants breeds true whilst the others break up. The American quality is a "recessive character," since it is completely obliterated in the external appearance of the first generation, and the Upland plant must therefore breed true. Further, it is known that all brown-linted cottons will breed true to that colour. Hence it is possible to isolate a plant bearing brown Upland lint and propagate it with the certainty that the offspring will resemble it in respect of the brown colour and Upland quality. This synthesis of a brown Upland cotton has been effected many times in the author's laboratory.

Moreover, in this experiment pure strains of white Egyptian and white Upland are obtained, so that, starting with brown Egyptian and white Upland, it is possible to recover the two parental forms and also effect two combinations with the production of Egyptian with the colour removed and Upland with the brown colour added.

An account is given of the results obtained in a study of a second case of inheritance, namely, that of yielding capacity, including the total production of flowers, the periodicity of flower production, the amount of boll-shedding, the time taken for maturation of the boll, the size of the boll, the form of the boll, the number of boll-divisions, the size of the seed, the density of the lint, and the length of the lint.

In conclusion, it is pointed out that, even in the case of crosses between Upland and Egyptian cottons, which yield most complicated series of offspring, the heredity can be step by step reduced to simple factors. In some cases, it has been possible by recombination of factors to form new characters, thus obtaining plants which breed true to a new seed-weight, a new habit of branching, or a new height. The opinion is expressed that breeding on Mendelian lines will well repay the extra trouble involved, and that the adoption of this practice will ultimately effect great alterations in the world's cotton supply. Emphasis is laid on the necessity of avoiding errors due to natural crossing.

THE RUBBER PLANTS OF TROPICAL COUNTRIES.

A number of special reports dealing with the rubber resources of various countries were presented.

The Rubber Resources of West Africa. BY HAROLD BROWN, *Technical Superintendent, Scientific and Technical Department, Imperial Institute.*—The paper deals generally with the question of the production of rubber in British West Africa, *i.e.* in the Gambia, Sierra Leone, Gold Coast, Northern and Southern Nigeria. It gives statistics of production; the names of the indigenous rubber plants and their distribution; the native methods of collecting and preparing rubber; the quality and value of the rubber; the improved methods of preparation and the resulting increase in the value of the rubber. The paper also includes an account of the present position of rubber cultivation in the various countries.

GAMBIA.—The indigenous rubber-yielding plants are species of Landolphia, principally *Landolphia Heudelotii*, but the vast majority of the vines have been destroyed by the methods of collection employed, and since 1905 very little rubber has been collected in the Colony itself. The exports in 1907 and 1908 were 61,405 lb. and 18,568 lb. respectively. No systematic cultivation of rubber plants has been attempted in the Gambia.

SIERRA LEONE.—The indigenous rubber plants include species of Landolphia and Clitandra (*L. Heudelotii*, *L. owariensis*, and *Clitandra* sp.) and the West African rubber tree, *Funtumia elastica*. The bulk of the rubber is collected in the Bandajuma, Panguma and Koinadugu districts. The exports in 1907 and 1908 were 164,463 lb. and 92,016 lb. respectively. The Para rubber tree (*Hevea brasiliensis*) and *Funtumia elastica* are being experimentally cultivated in the Colony.

GOLD COAST.—The rubber of this Colony is derived from *Funtumia elastica*, *Landolphia* spp. (principally *L. owariensis*) and *Ficus Vogelii*. Most of the Funtumia rubber is exported in the form of "lump," and owing to defective methods of preparation it is usually of inferior quality; attempts are, however, being made to remedy this. The

rubber of *Ficus Vogelii* contains a high percentage of resin. The chief sources of Gold Coast rubber are the forests of Ashanti, Sefwhi and Akim. The exports in 1907 and 1908 were 3,549,548 lb. and 1,773,248 lb. respectively.

Plantations of Para and Funtumia trees have been successfully established in the Gold Coast, and promise to give very good results. Experiments with other rubber-yielding plants are also in progress.

NIGERIA.—The principal sources of rubber in Northern and Southern Nigeria are *Funtumia elastica*, and species of Landolphia, Clitandra and Carpodinus vines. The Funtumia rubber is exported in the form of "lump," as in the Gold Coast, but efforts are being made to induce the natives to prepare it in "biscuits." The exports from Southern Nigeria, including those from Northern Nigeria, were 2,845,823 lb. and 1,222,203 lb. in 1907 and 1908 respectively; the production in Northern Nigeria was 1,187,588 lb. in 1907, and 509,454 lb. in 1908.

Experiments with a number of exotic rubber trees are in progress in Southern Nigeria. Plantations of the Para tree have been established in several localities, and so far have given very promising results. Large numbers of Funtumia trees have also been planted.

In Northern Nigeria plantations of Funtumia trees have been established.

Rubber in British East Africa. BY A. C. MACDONALD, *Director of Agriculture in the East Africa Protectorate.*—The indigenous rubber-yielding plants of British East Africa include species of Landolphia vines and the tree *Mascarenhasia elastica.*

Landolphia Kirkii is abundant in the Coast Belt, whilst another species is found on the Nandi Plateau in the Nyanza province at an elevation of 6,000 feet. The bulk of the rubber exported from the Protectorate has hitherto been obtained from these vines. In the Coast Belt much damage has been done to the vines by the native methods of tapping, but attempts are being made to remedy this.

Within the last two years *Mascarenhasia elastica* was found to be indigenous in the forests on the Shimba Hills, and experiments are now being made in order to determine its value as a source of rubber and its suitability for planting purposes.

Experiments are also in progress with Para, Ceará, Funtumia and Castilloa rubber trees. Except in a few favoured situations the climate of East Africa, even in the Coast and Lake regions, is not suitable for the Para tree. The Ceará tree has, however, done very well, and plantations aggregating from 1,500 to 2,000 acres have been already established, and extensive planting is going on. The paper gives particulars of some preliminary tapping experiments on Ceará trees at Witu.

Preparation of Rubber. BY PROF. CARMODY, *Director of Agriculture, Trinidad.*—A description is given of Mr. H. S. Smith's machine for

the separation of rubber from latex (English Patent No. 7433 of 1909). The machine is of the centrifugal type, but makes special provision for the escape of the dark, watery liquid resulting from the coagulation of Castilloa latex, and thus avoids discoloration of the rubber. Further, the machine admits of the addition of organic liquids for the removal of resins, so that it can be used for the preparation of good quality rubber from the resinous latex of young Castilloa trees.

Notes on Tapping Castilloa Rubber. BY J. B. CARRUTHERS, *Assistant Director of Agriculture, Trinidad.*—The yield of rubber from *Hevea brasiliensis* trees, over five years old, tapped on the "herring bone" or "V" system, may be taken as 1 lb. of dry rubber per annum, for each foot diameter of the tree, measured at 3 feet from the ground. In Castilloa trees, tapped by hatchets, chisels or axes or by the methods used for Hevea, the yield is much poorer and does not exceed 6 oz. per foot diameter, measured at 3 feet from the ground. The author considers that this smaller yield is due mainly to the lack of a system of tapping suited to Castilloa, and he has undertaken a series of experiments designed to discover a better system.

Experiments in pricking Castilloa trees, varying in diameter from 27 to 45 inches and in age from 7 to nearly 10 years, indicated that good results may be obtained in this way, and these trials are being continued. It was observed that Castilloa trees continued to yield latex for from 10 to 20 minutes after pricking, but that the period of flow could be lengthened to about 50 minutes by continuously spraying the pricked portion (10 × 10 inches in these trials) of the bark with water, and in this way the yield of rubber could be increased by from 20 to 40 per cent. The latex was collected by means of an unbleached calico "apron" of special form attached to the tree about 8 inches from the ground. A suitable "pricker" has yet to be devised for Castilloa, and the author is making experiments in this direction.

The other rubber reports presented were as follows: "Note on Hevea in West Africa," by M. Yves Henry (see p. 183); "Rubber in the German Colonies," by Dr. Warburg; "The Rubber of *Ximenia americana*," by Dr. Suzzi; "The Rubber Plants of the Tropics," by Senor G. Flores; "Exploitation of Indigenous Rubber Plants in the Belgian Congo," by M. Kindt; "Cultivation and Exploitation of Exotic Rubber Plants in the Belgian Congo," by M. Pynaert; and "The Rational Study of Rubber Plants," by Dr. Heim.

THE PLACE OF BOTANICAL GARDENS IN TROPICAL AGRICULTURAL RESEARCH.

In this inquiry special reports were presented by Prof. Engler and Dr. Volkens of the Royal Botanic Gardens, Dahlem (near Berlin), on the "Agricultural and Forestry Experimental

Stations in the German Colonies," by M. Capus of the Agricultural Department of Indo-China, and by Prof. Borzi, Director of the Colonial Garden at Palermo.

GENERAL PAPERS.

In addition to the reports referred to, on inquiries initiated by the International Association, a number of papers dealing with tropical agriculture were also communicated, of which the following are abstracts:—

Wheat Production in Relation to the Requirements of the United Kingdom. By A. E. Humphries.—The consumption in the United Kingdom of wheaten products per head of the population has remained practically constant for many years; the population has increased very greatly; the area of land in the United Kingdom under cultivation and grass is substantially the same as it was thirty years ago, and the acreage under wheat has decreased very much in that period; so the imports into the United Kingdom of wheat and wheaten products have greatly increased, and the quantity required per annum is not likely to diminish. The production of wheat in England is still important, and the profitableness of wheat-growing remains directly and indirectly one of the determining factors of the prosperity of British agriculture.

The profit to be obtained from the production of wheat depends not only upon satisfactory market values for the produce, but can be most materially affected by increasing the yields of grain and straw, and by other methods of reducing the cost of production per unit of quantity. Scientific research is of the greatest importance as a means to this end, and results obtained in recent years are likely to have effects of world-wide importance.

There have been in the last thirty years great changes in the methods of flour-milling, and mills are now so well equipped with processes and machinery, that millers are able to handle satisfactorily wheats of widely differing characteristics.

When the wheat produced in a district is milled therein, it is necessary to grow varieties, which best suit the local requirements, but British millers no longer ask that imported wheats should be mellow or soft or of any specific type or variety. They realise that under ordinary circumstances it would not pay the grower to produce wheats which would realise maximum prices, if such wheats were unfitted by their nature, to yield in any given set of natural conditions a maximum crop on an average of years. The British miller, especially if he be allowed to utilise the advice of the chemist and engineer in developing the potentialities of any wheat, is ready to buy at a fair price any kind of wheat offered to him.

It is difficult or impossible to lay down any definite standard of

supreme excellence as regards quality in wheat. The author, however, gives a list of points to be remembered by those wishing to sell wheat on British markets.

The author also summarises the results of an inquiry initiated by the National Association of British and Irish Millers into the causes of quality in wheat, and emphasises the very great importance, in the application of Mendelism to wheat, of Prof. Biffen's discoveries concerning the inheritance of disease and of quality of endosperm.

Work Done in the Testing of Wheat and Flour in the Chemical Laboratory of the Department of Agriculture, New South Wales. BY F. B. GUTHRIE, F.I.C., F.C.S., *Chemist to the Department of Agriculture, New South Wales.*—At first wheat was grown in New South Wales entirely in the Coastal Districts, and the chief difficulty experienced was the prevalence of "rust." Later on, this crop was extended to the arid and semi-arid districts, and it became necessary to find wheats which would be drought-resistant. The desire to breed wheats of good milling quality and yielding "strong" flours arose at a later date still.

The breeding and improvement of wheat in New South Wales was undertaken first by the late Mr. W. J. Farrer, about 1882. At first Farrer worked alone, but after 1895, when a small milling apparatus was installed in the chemical laboratory of the New South Wales Department of Agriculture, he worked in association with that laboratory. The first important work on wheat done in the laboratory was a comparison of the standard wheats in cultivation in Australia, with a number of exotic varieties, and also with breeds introduced by Farrer. In these investigations attention was directed mainly to the following factors, in the flours obtained on milling:—Colour, gluten content, water-absorptive power, behaviour on baking, volume of loaf produced. The water-absorptive power has been found to correspond in a fairly satisfactory manner with the "strength" of a flour, and may be taken as a measure of it.

In addition the change in character of imported varieties of wheat such as "Duluth" or "Manitoba," when grown for a series of years in New South Wales has been investigated. The results showed that in some districts imported varieties deteriorate, and in this respect are inferior to Farrer's cross-bred wheats.

More recently experiments have been undertaken on the blending of wheats and flours, and it has been found that considerable amounts of weak wheats can be blended with strong wheats for milling purposes, and "strong" with "weak" flours without impairing the "strength" of the flour as measured by its water-absorptive capacity or by the volume of the loaf produced on baking.

Investigations have also been carried out on the qualities of the flours obtained at various stages of milling.

Field experiments on the manuring of wheat and on the tolerance of wheats for noxious ingredients in the soil have also been made in conjunction with laboratory work.

The Work of the late W. J. Farrer, *Wheat Experimentalist to the New South Wales Department of Agriculture.* BY F. B. GUTHRIE, F.I.C., F.C.S. *Chemist to the Department of Agriculture, New South Wales.* **With Notes on Farrer's Methods of Work.** BY G. W. NORRIS.—W. J. Farrer began work on the improvement of wheat in New South Wales about 1882, and in 1898 became Wheat Experimentalist to the Department of Agriculture in that Colony. He endeavoured to produce types of wheat which would be resistant to rust and other fungoid diseases and to drought, and would yield "strong" flours. The last-mentioned of these three desiderata he secured, and at the present time certain of his cross-bred wheats are of greater value to the miller than any previously in cultivation in New South Wales. A large measure of success was also achieved in the production of rust and drought-resistant varieties, but the final value of this side of his work cannot be estimated yet.

After joining the Department of Agriculture in 1898 he was able to have milling tests made of each of his cross-bred wheats, and in this way was able to reject each season a large number of crosses, which were useless on account of their poor milling value.

In order that readers may appreciate the value of Farrer's work descriptive accounts are given in the paper of (1) typical, soft, weak, flour wheats, most commonly grown in New South Wales, (2) improved, soft, weak flour wheats resulting from Farrer's earlier cross-breeding experiments, and (3) strong flour, cross-bred wheats introduced by Farrer.

In these descriptive accounts mention is made of the origin of the wheat when known, its suitability to various parts of the State, its habit of growth, milling characteristics, etc.

The paper is completed by a series of notes contributed by Mr. Norris, describing Farrer's experimental station at Lambrigg and his methods of planting, selecting and crossing wheats.

South African Cereal Rusts, with Observations on the Problem of Breeding Rust-resistant Wheats. By I. B. POLE-EVANS, *Plant Pathologist, Department of Agriculture, Transvaal.*—Four distinct species of rust occur commonly in cereals in South Africa, viz.:—

(1) *Puccinia graminis*, Pers., the black rust found on wheat, barley, oats and rye.

(2) *Puccinia triticina*, Eriks., the brown rust on wheat.

(3) *Puccinia coronifera*, Klebahn, the yellow rust on oats.

(4) *Puccinia disperta*, Eriks, the brown rust on rye.

Of these *Puccinia graminis* causes very severe damage to wheat,

barley and oats. The oat crop also in some seasons is completely destroyed by *Puccinia coronifera* alone. The form *Puccinia graminis* on wheat infects barley readily in the summer months, but not during the winter. In the same way wheat is readily infected with the rust from barley in the summer, but not in the winter. The form on rye, usually found on the haulms, infects barley readily but not rye, wheat or oats. The form on oats does not infect any of the other cereals, nor can oats be infected from wheat, barley or rye.

As a general rule wheats, which exhibit immunity to *Puccinia graminis*, are extremely susceptible to *Puccinia triticina* and those showing immunity to *Puccinia triticina* are highly susceptible to *Puccinia graminis*, though some varieties are severely attacked by both rusts. English, American, Australian and Indian varieties of wheat said to be immune to rust in several countries do not retain their immunity when exposed to South African conditions. Indian oats which do not suffer from rust in India are highly susceptible to the rusts *P. graminis* and *P. coronifera*, when grown in S. Africa.

In the work of breeding rust-resistant strains of wheat in South Africa, it is found that the hybrids between immune and susceptible plants are far more susceptible to rust than the susceptible parents, and that the rust from these hybrids is not only able to infect the immune parent, but also produces a far more severe infection on both parents than does the rust from the susceptible parent. These hybrid wheats therefore act as "bridging species" or intermediaries in the passage of the rust from a susceptible to an immune variety, and there can be very little doubt that they play a very important part in the breeding down of immune varieties, such as commonly occur in nature.

The Production of Tobacco Leaf of the Yellow Virginia Type. BY G. M. ODLUM, *Tobacco Expert, Rhodesia.*—The name "yellow leaf" is preferred for this type of tobacco, since the term "bright tobacco," in common use for it, is also applicable to other types grown on soils of a different character and cured by other methods.

The first yellow tobaccos were produced more or less accidentally by sun-curing, during periods of favourable weather. A few growers then began to experiment in curing tobacco of this type by means of open charcoal fires, and this was rapidly superseded by the present method of applying heat by means of iron flues heated by a fire external to the curing barn.

The chief factors in the successful production of yellow leaf are the selection of a good type of tobacco by means of breeding experiments, a sandy soil, careful manuring, rapid, uniform growth, quick handling of the crop when it is ripe, and rapid curing by means of heated flues. All these matters are considered in some detail in the full paper.

Yellow tobacco is grown chiefly in the States of Virginia, North and

South Carolina, and Tennessee, and until quite recently these parts of the United States had a monopoly of the industry. During the last ten years, however, the industry has become established in Japan, Rhodesia and Nyasaland, and successful experiments in the production of this type of tobacco have been made in the Transvaal, Canada and elsewhere.

The Burning Quality of Tobacco. BY THOMAS ANDERSON HENRY, D.SC., *Superintendent of Laboratories*, and SAMUEL JAMES MANSON AULD, PH.D., D.SC., *Senior Assistant, Scientific and Technical Department, Imperial Institute.*—The cultivation of tobacco in a new country presents many difficulties to the planter, one of the most important being that of producing a tobacco that will burn well.

In order that a tobacco should smoke in a satisfactory manner, it is essential that it should burn evenly, slowly and completely. For cigar tobacco it is further necessary that it should leave a white or at most a pale grey ash, and the ash should be coherent and show no tendency to break up easily into powder or flakes.

These properties depend almost entirely on the nature of the mineral constituents of tobacco, and this in turn depends on the soil in which the tobacco is grown and the nature of the manures applied to it. One of the simplest methods of ascertaining the cause of bad burning in tobacco is to make analyses of the ash of the tobacco. The authors have made analyses of a large number of tobaccos of the principal kinds used in commerce, and on the basis of these results confirm the view that the chief factor influencing the burning quality of tobacco is the amount of potash in the ash. Lime and magnesia are also important and invariable constituents of tobacco ash, but their influence is practically confined to whitening the ash, and they are therefore of greatest importance in cigar tobaccos. Excess of lime, however, usually means reduction of potash, so that soils containing excess of lime are unsuitable for tobacco cultivation. Sulphates and chlorides are disadvantageous to the burning quality, and soils containing them are unsuitable for the cultivation of tobacco.

In manuring tobacco, potash should be liberally applied unless the soil is rich in this constituent, but nitrogenous manures and phosphates should only be applied in such amounts as will ensure satisfactory growth. Potash is best applied in the form of plant or wood ashes or as vegetable refuse. The paramount position of Cuba, Java and Sumatra in the cigar tobacco industry is probably mainly due to the great reserves of available potash accumulated in their soils by the deposition of the leaves of forest trees.

Methods of Cultivation and Varieties of Sugar Cane at the Sugar Experiment Station, Mackay, Queensland. BY H. T. EASTERBY, *Director of the Experiment Station.*—The first experiments were made in 1901,

and were devoted to showing the advantage in sugar-cane cultivation of a deep surface layer of thoroughly tilled soil. For this purpose the soil was broken up, then ploughed to a depth of 12 inches, and the sub-soil thoroughly stirred to a further depth of 6 to 8 inches. This treatment was followed by cross ploughings, producing a loose mass of soil 18 to 20 inches in depth. In such soil "Rose Bamboo" cane, planted in April 1902, gave a yield of 15,073 lb. of sugar per acre, as compared with 8,821 lb. per acre obtained by ordinary cultivation, as carried on in Queensland. In further experiments made with ratoon canes, similar large increases in yield were obtained where the ground between the rows was ploughed and sub-soiled.

Methods of planting have also been studied, and the results are all in favour of close-planting, the best distance being four feet between the rows.

Experiments in manuring showed that a mixed manure, made up of ammonium sulphate 250 lb., sodium nitrate 150 lb., potassium sulphate 100 lb., and calcium superphosphate 500 lb. per acre, gave an increased yield of 16 tons of cane per acre.

One hundred and twenty-four varieties of cane have been tried at the Station. Of these 70 were obtained from New Guinea, and 11 of them have been retained for extended trial. Five of these selected canes, viz. 8A, 15, 24, 24A and 24B are of first grade, and have yielded from 18·4 to 20·5 per cent. of sucrose per annum on the average during the years 1904–1908.

Of the other 54 varieties some have been discarded, and others are still under trial, but none of them have proved as good as the best canes introduced from New Guinea. Seedling canes have proved less vigorous at Mackay than the standard canes of the country, and are also inferior to the selected New Guinea varieties. The work now in progress includes the introduction of further New Guinea kinds and standard varieties from other cane-growing countries.

The "gum disease" (*Bacillus vascularum*) causes serious trouble both in the field and in the mills, especially in the cooler districts. The best of the New Guinea varieties may prove immune to this disease. Observations at Mackay do not lend any support to the view that canes showing a high acidity are less susceptible to "gum disease" than other sorts. Reference is also made to the damage done by insect pests.

Causes contributing to the Success of the Zanzibar Clove Industry. BY R. N. LYNE, F.L.S, F.R.G.S., *Director of Agriculture, Zanzibar.*—Cloves were introduced into Zanzibar and Pemba by the Arabs from the Moluccas *via* Reunion, about 1818, but some years elapsed before the peculiar suitability of the country for the cultivation of cloves was discovered. In 1860 H.M. Consul in Zanzibar stated that the annual output was about 7,000,000 lb. The industry has passed through

several crises. In 1871 the United Kingdom imposed on Zanzibar a Treaty prohibiting slave traffic, and a year later a hurricane destroyed every clove and cocoanut tree on the main island. Fortunately, however, Pemba was spared by the hurricane, and profited by the resulting high price of cloves. Replanting was undertaken immediately in Zanzibar, and by 1895 the output had risen to twice that of the pre-hurricane period. But prices fell in 1895, labour was scarce, and to add to these difficulties came the bombardment in 1896, the abolition of the legal status of slavery in 1897, and a smallpox visitation in 1898, which decimated the native population, and was followed by a period of severe drought. In spite of these difficulties the industry persisted and is now in a more flourishing condition than it has ever been before.

Apart from the suitability of the soil and climate of the islands to the needs of the clove tree, the industry largely owes its success to the skilful way in which the Arabs have utilised native labour. In particular they have always endeavoured as far as possible to accommodate their business ways to those of the native; thus the remuneration of the native labourer per day is the same, no matter what quantity of cloves he picks, and this method appears to answer well in practice, at least with Zanzibar and Pemba natives. Further, clove-picking is practically the only industry in the islands, and consequently the Arabs have been able gradually to teach this to the whole native population, and they are thus spared the difficulty often experienced by European planters in Africa, that no sooner is a native educated to a particular class of work than he leaves the plantation to take up something else.

It is considered that in other African colonies similar advantages might well result if more attention were given to the habits, disposition and prejudices of native labourers.

The Aromatic Grass Oils. By SAMUEL S. PICKLES, D.Sc., *Senior Assistant, Scientific and Technical Department, Imperial Institute.*—The paper deals with the chemical examination of a large number of samples of Cymbopogon oils, chiefly citronella oils, most of which were obtained from grasses carefully cultivated by Mr. J. F. Jowitt at Bandarawela in Ceylon. The oils examined include several specimens of the two well-known citronella oils of commerce obtained respectively from "Maha-pengiri" (or Winter's grass) and "Lena-batu," besides a number of oils obtained from the various wild "mana" grasses of Ceylon. In addition to these there are also included the results of the examination of lemongrass oils from *Cymbopogon citratus*, Stapf., and *C. flexuosus*, Stapf., "Delft grass" oil from *C. polyneuros*, Fiji lemongrass oil from *C. coloratus*, Stapf., and a Cymbopogon oil from the Sudan, supposed to be from *C. Jwarancusa*, Stapf.

Citronella Oils. The following general conclusions can be drawn from the results obtained with these oils :—

(*a*) Speaking generally, the grass grown in the period, June to September, gives a larger yield of oil, generally better in quality than the older grass which is grown during the months September to June. (*b*) The effect of manuring is to produce a general improvement in the quality of the oils. (*c*) The marked difference in chemical composition of the "Maha-pengiri" and "Lena-batu" grass oils seems to indicate that the two oils are derived from different species. (*d*) The results obtained in the analysis of the oils from the wild "mana" grasses show that, in character, many of them are similar to the "Lena-batu" oils. The chief difference is in the yield, the "Lena-batu" grass giving from 2 to 3 times the amount of oil obtained from most of the "mana" grasses.

Lemongrass Oils.—Comparison of the oils of *C. citratus* and *C. flexuosus* confirms the view recently expressed by Stapf. that the former produces the so-called "insoluble" lemongrass oil, whilst the latter yields the so-called "soluble" oil

"*Fiji Lemongrass Oil.*"—This oil was received from Fiji as "Lemongrass oil." On examination it was found to resemble a mixture of lemongrass and citronella oils. A botanical specimen of the plant yielding the oil was identified at Kew as *C. coloratus*, Stapf.

Oil of *Cymbopogon polyneuros*, Stapf.—This oil has not been described previously. It has a pleasant, penetrating odour, recalling that of anise. The grass occurs in considerable quantities in certain parts of India, and the oil may prove to be of commercial value.

Oil of *C. Jwarancusa*, from the Sudan.—This is an interesting oil which, in general properties, somewhat resembles oil of pennyroyal. The principal constituent of the oil is an aromatic ketone, having an odour like that of pulegone. It is the first example of an oil of this type yielded by a Cymbopogon grass. The botanical identity of the grass has not yet been confirmed.

Cover Plants as a Substitute for Clean Weeding. BY J. B. CARRUTHERS, *Assistant Director of Agriculture, Trinidad.*—The clean weeding of estates as practised in the Tropics is a legacy from experience in temperate countries, and has given excellent results, so that planters are not naturally inclined to abandon it. There are, however, certain conditions obtaining in the Tropics, which render clean weeding disadvantageous. The chief of these are as follows:—(1) Denudation by tropical rain is severe on land, which is regularly weeded and consequently has its upper layers of soil in a loose and friable condition, (2) The soil thus lost is rich in plant food, and though part of it may be recovered by an efficient drainage system, the recovered portion is not re-spread and consequently is of little value to the estate as a whole, (3) Clean weeded land dries and hardens in the sun so that the upper layers of the soil become inefficient for cultivation purposes, (4) The cost of clean weeding sometimes forms as much as 60 per cent. of the

total cost of working an estate, and labour needed for other purposes has often to be diverted to this work.

These difficulties may be avoided by using cover plants to prevent the growth of grasses and weeds. Plants suitable for use in this way should have the following characteristics :—(1) They should shade the ground without producing an impermeable, matted surface, (2) they should remain green in drought, (3) they should be of sufficiently vigorous growth to prevent the growth of weeds, grasses, etc., (4) they should not grow more than 2 feet high so that they do not interfere with the crop. It is further an advantage that the plants should be leguminous, so that the soil in which they grow may become enriched in nitrogen by their aid. The following provisional list of suitable cover plants is suggested :—*Mimosa pudica*, *Tephrosia purpurea* or *T. candida*, *Crotalaria striata* or *C. incana*, *Abrus precatorius*, *Mucuna pruriens*, *Desmodium triflorum*, *Vigna* spp., *Passiflora foetida*, *Ipomœa batatas* (sweet potatoes).

Fibres in British East Africa.—BY A. C. MACDONALD, *Director of Agriculture in the East Africa Protectorate.*—There are many plants indigenous to the East Africa Protectorate which yield valuable fibres. The most important of these are the various species of *Sansevieria*, the botanical determination of which is now in progress at Kew. The fibre which has been exported hitherto has been chiefly derived from *S. Ehrenbergii* and *S. sulcata*. Another species, which has not yet been determined, yields a fibre of good quality, but shorter than those of the foregoing. *S. Kirkii* occurs in parts of the coast belt, and *S. guineensis*, or a closely allied species, is widely distributed; both these plants furnish a good fibre. The plants grow in a kind of jungle through which paths have to be cut to the track on which the leaves are conveyed by trolleys to the factory; this, of course, increases the cost of collection. Two factories have been established for extracting the fibre, one at Voi, and the other at Masongaleni. The machines employed are the "Finigan Zabriskie," and the "New Corona." The fibre, after leaving the machine, is usually washed with water, dried in the sun, and afterwards beaten or brushed, and baled for export.

A wild banana (*Musa* sp.) is widely distributed in the Protectorate; it is propagated from seed, and usually requires from 2 to 2½ years to reach maturity. A useful fibre is obtained from the sheathing petioles of the plant by a method of beating, scraping, washing, and drying. Samples of this fibre have been examined at the Imperial Institute, and found to be of good length, strength, and colour, and comparable with the higher grades of Manila hemp (this *Bulletin*, 1907, 5. 228). The product has not become an article of export owing to the lack of suitable machinery for its extraction, and owing to its preparation by hand being expensive and unreliable. If, however, a satisfactory machine were introduced, there is no doubt that a profitable industry

could be established, as not only could the wild plants be utilised, but a permanent supply could be readily obtained by cultivation.

Several indigenous fibre plants are made use of by the natives. The leaflets of the raphia palm yield a fibre employed for basket-making and as a tying material. Baobab fibre (the inner bark of *Adansonia digitata*) is used for making mattresses and bags and also for binding house poles together. This fibre is sometimes employed in the United Kingdom for paper-making, but has not been exported from British East Africa for the purpose. The leaves of a dwarf variety of the "dom" palm (*Hyphaene coriacea*) are used for making mats, baskets, and bags. The leaflets of another palm (*Phœnix reclinata*) are found to be useful for making sleeping-mats. The bast fibre of *Hibiscus diversifolius* is in demand for binding house poles together and for making bags.

Exotic Fibre Plants.—The cultivation of Sisal hemp (*Agave sisalana*) was started in British East Africa about six years ago, and fibre of good quality has been obtained (this *Bulletin*, 1909, 7. 160). Progress was delayed by the difficulty of obtaining suckers and bulbils, but this has now been surmounted; about 2,000 acres are at present under cultivation, and the area is being extended.

Mauritius hemp (*Furcræa gigantea*) and Manila hemp (*Musa textilis*) have been grown experimentally. Ramie has been grown with success, but a remunerative industry cannot be established in the absence of suitable decorticating machinery. Coir, the fibre obtained from the husk of the coconut, is prepared in small quantities, and used locally for cordage manufacture.

Re-afforestation in the Tropics, with Special Reference to Eucalypts. BY R. DALRYMPLE-HAY, *Director of Forests, New South Wales.* — Re-afforestation is used to denote natural regeneration of trees, as distinct from afforestation, which implies the formation of forests by arboricultural methods. Speaking broadly, there are two types of forests in the sub-tropical and tropical parts of Australia, and each of these includes characteristic species. The first type comprises open forests containing chiefly Eucalypts, and the second brush or jungle containing many genera, principally soft woods. As a group, Eucalypts require much moisture, and provided the soil is suitable in this respect, they naturally reproduce well if care is taken to exclude grazing animals, and the necessary air, light, and growing space are supplied by the destruction of inferior growths.

The re-afforestation methods to be followed vary in detail with the species under treatment and the results sought, but, in general, it may be stated that seedling growth is of first importance for the production of high-class timber, sucker growth being next in value, whilst coppicing affords wood only suitable for use as fuel or as mining timber. The application of these general principles in re-afforestation by "Flooded

gum" (*Eucalyptus rostrata*), and by mixed Eucalypts and other hardwoods is discussed in detail.

Jungle forest is less easily re-afforested than the open type, and so far the best results have been secured by clearing it in sections, and then broadcasting the seed of desirable species which it is sought to establish.

The Introduction of the "Remarkable Pine" (*Pinus insignis*) into South Australia and its Successful Utilisation. BY WALTER GILL, F.L.S., F.H.R.S., *Conservator of Forests, South Australia.*—This pine was introduced into Australia by the late Baron F. von Müller. It is indigenous to the South Western portion of the United States from Pescadero to Monterey. It does well in South Australia at elevations high enough to moderate the effects of drought, but in the hot plains is far less resistant than the "Aleppo pine" (*Pinus halepensis*).

For planting purposes the tree is reared in open beds from seed, and can usually be planted out after one year's growth, except where the ground is liable to be overgrown with ferns or shrubby vegetation, in which case plants two years old should be used. Test plantings indicate that the best spacing to adopt is 9 × 9 feet.

The timber has proved particularly useful in South Australia for the construction of packing-cases for fruit, since it can be nailed and re-nailed without splitting. It is also serviceable for the construction of domestic furniture and for other purposes.

Some Important Insect Pests in British West Africa. BY GERALD C. DUDGEON, *Inspector of Agriculture for British West Africa.*—An account is given of certain insect pests of British West Africa. *Aphis sorghi*, Theob., has caused serious damage to the "Bassi" (*Sorghum vulgare*) crops in the Gambia.

The American cotton boll-worm (*Heliothis armigera*) and a species of *Earias* allied to the Egyptian cotton boll-worm have injured the cotton crops in certain localities in Northern Nigeria. Several species of *Oxycarenus*, the cotton seed bugs, have done much harm by destroying the seed of the cotton plants. The West African cotton stainer, *Dysdercus superstitiosus*, occurs commonly in the cotton fields.

Certain Coleopterous larvæ (*Glenea* sp.), occasionally bore into the trunks and branches of the cocoa trees. *Sahlbergella theobromæ*, Dist., a species of *Capsidæ*, known as the black cocoa bark sapper, has caused the destruction of many of the trees in some of the Gold Coast plantations. Another capsid, *Helopeltis* sp., has been found puncturing cocoa pods in the Eastern part of the Gold Coast.

A Lepidopterous larva, *Glyphodes* sp., has been observed to defoliate indigenous rubber trees in the Botanic Gardens at Aburi. Plantations of *Castilloa elastica* have been ruined by the attacks of a Coleopterous boring larva, *Inosida leprosa*, and seedlings of *Hevea brasiliensis* have

sometimes been destroyed by *Apate monacha.* Coconut trees in certain plantations of the Western Province of Southern Nigeria have been rendered unhealthy by being infested with a scale insect *Aspidictus destructor.*

The damage caused by these pests is described, and in certain cases remedial measures are suggested.

The remaining papers read in this section were as follows: "Influence of the Relation between Lime and Magnesia in Soil on Plant Development," by L. Bernardini and A. Siniscalchi of the Portici Agricultural Station; "Magnesia in Agriculture," by M. Rigaux; "Manures for the Cultivation of Tropical Plants," by Dr. Fesca, of the Colonial Institute, Hamburg; "Birds *versus* Crops," and "Sanitation on Rubber and Cocoa Estates," by H. H. Smith; "The Cultivation of Bamboos," by J. Houzlan, and "Exploitation of Forests in the Belgian Congo," by H. Lonay.

SECTION II.—STOCK-BREEDING AND RURAL INDUSTRIES.

This section was principally concerned with the reading and discussion of reports, received in connection with the general inquiry on "The Essential Factors in the Acclimatisation of European Cattle in Tropical Countries," on which Prof. Meuleman, of the Belgian Military School, acted as General-Reporter. Reports on this subject were also received from M. Douarche for Tonkin, M. Monod for Algeria, M. Peralta for Costa-Rica, Dr. Schilling for German Colonies, and Senor Valero of the Veterinary School, Madrid. The papers read in this section included the following:—

Economic Zoology in African Colonies. BY E. M. JARVIS, M.R.C.V.S., *Government Veterinary Surgeon, Department of Agriculture, Rhodesia.*—The conditions of life in Africa are not easily realised by Europeans. The varied and prolific vegetation has given rise to innumerable animals, insects and lesser organisms, which are inter-dependent, and devastating diseases arise from this close association, and these are the bane of the country.

By reason of the comparatively recent character of the colonisation, scientific research has but begun to be applied in Africa, and it behoves all Governments that their settlers should be properly provided with veterinary advice and protection before allowing them to embark in, or attempt development in the live-stock industry.

Ranching conditions as conducted in many other new countries are unsuitable, and require much modification to local needs, and the conservation of food is a necessity. Large European breeds of cattle are generally unsuited to tropical climates where parasitic invasions of the blood are prevalent, as such animals have no hereditary resistance, neither are they sufficiently active to fend for themselves: nor are they of a type to bear exposure to the heat, and the adverse conditions prevailing in periods of drought.

Breeding of Stock suitable for the Tropics. BY PROF. CARMODY, *Director of Agriculture, Trinidad.*—Efforts have been made for many years past to introduce breeds of cattle into Trinidad for the improvement of the meat- and milk-producing qualities of the local stock, and the chief obstacle has been found to lie in the high mortality among imported cattle.

The following points have now been established. The mortality is lowest among animals imported at the age of two or three years. Cattle with thick coats are unsuitable. It is advantageous to import a bull and two cows of the same breed, one of the cows being in calf from another bull of the same breed. The imported cattle must be kept free from ticks by the constant use of washes.

Red Poll crosses have proved most successful and next to them Shorthorn crosses. Holsteins and Jerseys are now under trial.

For the improvement of draught cattle for use on sugar estates the Zebu and Buffalo were introduced about 1879. The former has done well when crossed with the small native cattle and every sugar estate now possesses a large Zebu herd.

Sheep have proved quite unsuitable to Trinidad. Of pigs, Berkshire, Tamworth and Poland-China breeds have been found most suitable.

Horse-breeding has been fairly successful, but too much attention has been given so far to thorough-bred racing sires. The Hackney is more likely to be suitable and has been tried with success.

Mule-breeding has been tried with good imported Jacks, but in this, as in horse-breeding, too little attention has been given to the selection of suitable mares.

African Wild Silks. BY F. W. BARWICK, *Senior Assistant, Scientific and Technical Department, Imperial Institute.*—At the present time the most important African silk-producing insects are those of *Anaphe* species, belonging to the *Eupterotidæ*. The genus *Anaphe* occurs in many parts of Africa, and the following species have been recorded—*Anaphe panda* and *A. reticulata* in Natal; *A. infracta*, *A. Carteri* and *A. Moloneyi* in East and West Africa; *A. ambrizia* in Portuguese West Africa, Northern Nigeria and Uganda; *A. venata* in West Africa; *A. subsordida* in Lagos and Southern Nigeria, and *A. clarilla* in Rhodesia.

The silkworms live in large companies and move together in search of food. Shortly before the commencement of the period of pupation, the worms co-operatively construct a hollow silken nest, inside which they spin their individual cocoons. The colonies or nests are of irregular shape and size; the larger ones containing a hundred or more cocoons, whilst others are small and contain ten or even fewer cocoons.

The nests usually consist of several layers of silken material; the outer layers are somewhat coarse and loosely spun, whilst the inner layer is hard and of a parchment-like texture. The nests and single cocoons are usually of a dull reddish-brown colour, but it is stated that when the worms are enclosed in the dark they spin white cocoons.

The silkworms are said to feed principally on the leaves of species of *Ficus*, but the nests are found on almost all forest trees.

Anaphe silk contains a considerable quantity of "gum," which is more resistant to the action of ordinary degumming media than that of *Bombyx* or Tussur silk. Experiment has shown that treatment with alkali and soap solution will effect the removal of the gum. Specimens of nests, which have been examined, have been found to yield about 33 per cent. of clean degummed silk. This figure must be regarded as approximate only, since the composition and size of the nests vary to a considerable extent.

Anaphe silk resembles *Bombyx* silk and is capable of being spun into satisfactory yarn, but, unfortunately, the actual yield of clean degummed silk is very small. The probable value of the crude nests is about one franc per kilo, or two to three francs per kilo for the clean and sorted silk, in the gum.

Whether a constant supply of the material can be obtained at such a price as to render its collection and manufacture profitable has not yet been definitely established.

Paper from Megasse. BY PROF. CARMODY, *Director of Agriculture, Trinidad*.—Attention has been directed at various times to the possibility of utilising "megasse," or sugar-cane refuse, for paper-making, and as long ago as 1839 a process for the purpose was patented. Since that time little advance has been made, and the megasse is generally used as fuel for heating the boilers in the sugar-factory. The question was again brought into prominence when the late Mr. Bert de Lamarre, of the Tacarigua Factory, Trinidad, announced that he was able to convert megasse into paper of fairly good marketable quality. It was found that the crude crushed fibre was too bulky to permit of its exportation being profitable, and it was therefore decided either to convert the material into "half-stuff" before shipment or to manufacture paper from it locally.

A modern, well-equipped paper-making machine has therefore been imported and erected, and has hitherto been used for carrying out experimental trials. These have shown that paper of better quality can

be obtained by blending the megasse with other fibrous materials, such as banana leaves and stems, maize residues, *Agave*, *Hibiscus*, bamboo "bois de Canon" (*Cecropia peltata*), sunflower, native grasses, and other products. The best results have been obtained from a blend of megasse, bamboo and Para grass.

It is estimated that for every ton of cane sugar produced there is a ton of fibrous refuse, and hence in Trinidad there are 50,000 tons of fibrous material available per annum. This amount would probably yield 40,000 tons of pulp, worth at least £200,000. If a better class of paper pulp was prepared, the yield would possibly be reduced to 30,000 tons, worth £12 per ton, or a total of £360,000; or if the megasse was blended with bamboo and Para grass, the pulp would be worth £15 per ton or a total of £450,000. Much of the paper could no doubt be used locally for wrapping purposes. The utilisation of sugar-cane refuse in this manner is regarded as well worthy of consideration by those engaged in the cane sugar industry.

SECTION III.—LABOUR, TRANSPORT AND TRADE.

Two general inquiries were dealt with in this section, viz. "Agricultural Labour Conditions in Tropical Colonies," for which M. Batalha-Reis, Consul-General for Portugal in London, acted as General-Reporter, and that on "Alcoholism in the Colonies," which was in charge of Dr. Kermorgant of the Paris Academy of Medicine. In connection with the former inquiry reports were submitted from the following British Dependencies: Barbados, Leeward Islands, Bahamas, Jamaica, Sudan, Southern Rhodesia, Nyasaland, Swaziland, Bechuanaland, Basutoland, Transvaal, Cape Colony, Mauritius, India, Ceylon, Hong Kong, Wei-Hai-Wei, Gambia, Sierra Leone, and Gold Coast.

Reports were also furnished for German East Africa and the Cameroons, and for the Belgian Congo. The following paper was contributed to this section:—

Influence of Malaria on Labour Supply. BY PROF. CARMODY, *Director of Agriculture, Trinidad.*—The natural scarcity of labour in tropical countries is frequently further accentuated by loss or inefficiency due to attacks of malaria. The free distribution of quinine has been tried in some countries as a remedy, and has been in operation in British Guiana for over a year, with results that are stated to be favourable, though no statistics have yet been published.

The supply of agricultural labour in Trinidad has to be augmented by the annual importation of 2,500 immigrants from India, who are indentured to sugar and cocoa estates for five years. They are carefully

looked after by the staff of the Medical Department and the Protector of Immigrants, and the loss of labour in their case may be taken as the minimum that may be expected under favourable conditions. The cocoa estates are mostly on hilly land and the sugar estates on flat lands, and the difference in the percentage of malarial cases is, as is to be expected, very much in favour of the cocoa estates.

The number of immigrants on sugar estates approaches 10,000, and with the exception of 1905 and 1909 the total number of cases of malaria each year since 1900 has always exceeded the total number of immigrants. In 1909 the number of indentured immigrants on sugar estates was 8,142 and the total cases of malaria 7,744, which represents a labour loss to the Colony valued at 2323.20 dollars if the attack lasts one day and 9292.80 dollars if it lasts four days. To this must be added the loss of efficiency during convalescence, which may last from 10 to 12 days. The immigrants are on the whole a healthy race, as shown by the low death rate among them.

There is the further loss of labour due to attacks of malaria among the unindentured immigrants and the non-immigrant agricultural population, which is probably at least as serious. In the aggregate this represents a serious loss of labour per annum, which could be prevented to a large extent by the cheap distribution of quinine.

The final general meeting of the Congress was held on Monday, May 23, under the presidency of M. Tibbaut, Vice-President of the Belgian Chamber of Representatives. At this meeting the secretaries of the various sections presented reports on the work done, and these were approved. In his closing address M. Tibbaut announced that the International Association of Tropical Agriculture and Colonial Development had elected Prof. Wyndham Dunstan, LL.D., F.R.S., Director of the Imperial Institute, to be President of the Association in succession to M. de Lanessan, formerly Governor of Indo-China, who had held this office since 1905, but had now resigned it on account of ill-health. It was also mentioned that the next Congress would probably be held in London.

THE CULTIVATION, PREPARATION, AND UTILISATION OF THE GROUND-NUT.

THE ground-nut of commerce is known under several common names, such as pea-nut, goober-pea, earth-nut, monkey-nut, pindar, Manila nut, Chinese nut, pistache de terre, l'arachide

and in the vernaculars of India and other countries where it is grown, by translations of one or other of the names mentioned.

The plant which produces the ground-nut is known botanically as *Arachis hypogæa*, Linn. It is unknown in a wild state and its native country has been a matter of some uncertainty. There is reason to believe, however, that it orginated in tropical South America, as several species belonging to the genus Arachis are met with growing spontaneously in that country. Centuries of cultivation have probably so improved the plant that it is no longer comparable with the wild type, if this is still in existence.

Arachis hypogæa is an annual herbaceous plant belonging to the Papilionaceæ, a sub-order of the large natural order Leguminoseæ, whose members are characterised by pea-shaped flowers. In general habit and appearance the plant resembles clover. The leaves, however, differ from those of clover in having four instead of three leaflets. These are arranged on the leaf-stalk in two pairs, and they exhibit at night the sleep-movement characteristic of the leaves of many leguminous plants. The stems attain a length of from one to two, or three feet, according to the variety and the soil in which it is cultivated. There are several forms of the plant in cultivation, but only two general types are recognised, the erect and the trailing. The varietal differences are chiefly in the shape of the mature pod, the number and colour of the seeds they contain and the manner in which the pods are produced on the stem of the plant. The flowers are bright yellow in colour and are of two kinds. Those that are borne above the leaves and are the most conspicuous are sterile and produce no pods. The fertile flowers are borne in the axils of the lower leaves in the erect growing kinds, and all along the stem in the trailing varieties; they are smaller but more numerous than the sterile flowers and are almost entirely hidden by the foliage. When first produced, the flowers are sessile, that is to say they have no peduncle or flower-stalk, but the tubular calyx, which encloses the ovary is often ¾ inch in length, and is sometimes mistaken for the flower-stalk. After fertilisation takes place the true peduncle develops and continues to grow until it reaches a length of several inches. It takes a downward

turn, and when it reaches the soil it pushes the ovary several inches beneath it. In this position the ovary develops its seeds and in a few weeks the pod matures, forming the familiar ground-nut of commerce. If the stalk is prevented from penetrating the soil, no seeds are produced and no pod is formed. This peculiarity is of importance to the cultivator, as it indicates how essential for this crop is a fine surface tilth on the soil, which enables the delicate flower-stalk bearing the ovary to penetrate it easily. When mature, the pod may contain from one to as many as four seeds, according to the variety, but two is the usual number. The seeds are generally ovoid in shape with one end pointed and the other flattened, covered with a reddish-purple or yellow seed coat.

In common with many leguminous plants, the roots of the ground-nut plant bear nodular growths. These are due to the action of nitro-bacteria which inhabit them, and which have the power of fixing the free nitrogen of the atmosphere and rendering it available for the plant which serves as host. In consequence of this the ground-nut plant does not depend entirely upon the soil for the nitrogenous food it requires, and it is thus possible to cultivate ground-nuts on soils, which are not particularly rich in nitrogenous constituents.

The cultivation of the ground-nut extends over a very wide geographical area. It is successfully grown in most of the tropical and sub-tropical regions of the world, and its culture is also carried on to a certain extent in countries where a temperate climate prevails. The crop is used either locally as food, or as an article of export on account of the value of the seeds as a source of oil.

The countries where ground-nut cultivation plays an important part in agricultural operations are India, Indo-China, Japan, Java; the South Atlantic States of North America, especially Virginia, Tennessee, the Carolinas and Georgia; Mexico, the Antilles, Curaçoa and Jamaica; Brazil and the Argentine Republic; the West Coast of Africa, Mozambique, Madagascar, Algeria and Egypt. In Europe it is successfully grown in Spain and in Sicily. Recently the cultivation of the ground-nut has been considerably extended in the British Colonies and Protectorates, especially in Africa and Burma.

The principal countries which furnish large supplies to Europe are the West Coast of Africa, particularly the Gambia and Senegal; India and Mozambique. The large crops raised in the United States of America and in Spain are consumed in the countries of production mainly in the form of food products of various kinds.

CULTIVATION.

The ground-nut is not a difficult crop to cultivate provided the few essential conditions are forthcoming. The details of cultivation naturally differ in countries so widely separated as are the regions mentioned above, but the following account gives the general procedure in most countries.

Climatic Conditions.—In tropical countries the life cycle of the ground-nut plant is accomplished in from three to four months according to the variety. In more temperate regions some five to six months may elapse between the time of sowing the seed and the maturing of the fruit. It is apparent from a study of the geographical area over which the ground-nut is cultivated that it is possible to grow this crop under climatic conditions which differ considerably. In tropical regions there is always sufficient heat for this crop, and the only uncertain element is the rainfall. In temperate countries the summer heat usually suffices to mature the pods although a longer time is required, but the late frosts in the spring and the early frosts of autumn are frequently a source of danger to the crop. A temperature of 58° or 59° F. appears necessary for the young plants when commencing growth, and any diminution of warmth, even if it be only 2° or 3°, affects them detrimentally. As a guide, it may be stated that where maize can be grown and ripened the ground-nut may be successfully cultivated, and in the Transvaal Department of Agriculture *Farmer's Bulletin*, No. 15, it is stated that wherever citrus fruits can be grown the climate may be regarded as suitable for ground-nuts. In temperate regions, a period of at least five months free from frost is necessary in order to mature the crop, the most favourable conditions being an early spring, followed by a warm, even, summer temperature with a well-distributed rainfall, and a dry autumn. The sowing takes place

as soon as all danger from frosts is over and the condition of the soil is such as to admit of working it.

In tropical countries with a well-defined wet and dry season the ground-nut crop is cultivated during the rains, and the whole of the vegetative growth is completed during the wet season. The sowing takes place as soon as the rains have sufficiently moistened the soil, and by the time the dry weather sets in the crop is mature and ready for harvesting.

On the West Coast of Africa the rains are accompanied by a rise in temperature, and these climatic conditions suit the ground-nut admirably; its growth is rapid and the crop matures quickly. In Madras the seed is sown from the middle of June to the middle of August on rain-watered land, and on irrigated land from the middle of August to the middle of September. In Bombay it is usually a "kharif," or rain crop, and is sown in June as soon as the rains have sufficiently moistened the land, but in the Deccan it is grown as a "rabi," or winter crop, on irrigated land.

Soil.—The first condition required of a soil destined for the cultivation of ground-nuts is that it should have a fine surface tilth. The necessity for this arises from the peculiarity of the plant, already mentioned, in burying its fertilised ovaries beneath the soil in order to mature the seeds. A fairly rich sandy loam appears to be the most suitable soil for this crop, and it is an advantage if it is light in colour as the pods are liable to be stained if grown in a dark-coloured soil. When required for sowing or for oil pressing, the appearance of the pods is not of great importance but when the seeds are to be used for edible purposes, light-coloured, clean pods fetch an enhanced price on the market. Abundance of lime is essential for this crop, and where lime is lacking it should be added in the form of quick-lime. The absence of lime from the soil is supposed to account for the production of "pops," or empty pods. A fair amount of humus or decayed vegetable matter is beneficial, but if too plentiful the haulm is liable to develop at the expense of pods. Badly drained, sour, salt or clayey soils are unsuited to this crop, but good yields have been obtained from stony soils rich in sand where a plentiful supply of moisture is available.

Preparation of the Soil.—If new country is being brought into

cultivation it will be necessary to cut down trees, shrubs or undergrowth, should they exist, and these should be burnt on the land, as the ashes form a valuable manure for ground-nuts. In countries where primitive methods of culture are practised the land is simply hoed by hand to a depth of from 2 to 4 inches. In sandy soils the surface is left level, but in soils more compact it is thrown into ridges to afford better drainage. Where mechanical appliances are available the land is ploughed a short time before sowing if a previous crop, such as corn, has been taken off it; but if it is to be newly broken, the preliminary ploughing is carried out in autumn and is followed in spring by rolling and harrowing to break up the clods and render the surface smooth and friable. The depth of ploughing depends entirely upon the character of the soil, but from 5 to 7 inches of loose soil is sufficient depth for the ground-nut. Where there is no manure to be turned in and the land is in a clean condition, the disk plough, as used in the United States, is a useful machine for producing the fine surface tilth required by this crop.

It is advisable to cultivate the ground-nut as a rotation crop, as not only does this practice prevent the exhaustion of the soil, but the alternating crops are benefited by the good culture which the ground-nut demands and by the increased amount of nitrogenous matter contained in the soil as the result of having borne a leguminous crop. Local practice and demand will to a certain extent determine what plants to use as rotation crops with ground-nuts; amongst others that have proved suitable are maize, millet, sesamum, cotton, tobacco, and manioc (cassava). In all cases when grown in rotation, ground-nuts should follow a well-cultivated crop that has been kept free from weeds.

Manures.—Advantage should be taken of the rotation system of cropping to apply farmyard manure to the land, but if this is done the same year that a crop of ground-nuts is grown, the haulms are liable to make rank growth at the expense of the nuts. It is therefore advisable to manure the crop, which immediately precedes the ground-nuts.

In addition to farmyard manure, artificial fertilisers may be used with advantage if the soil is poor, but care should be taken not to overdress the land or luxuriant top growth will be the

only result. These fertilisers should contain from 2 to 4 per cent. of available nitrogen; 5 to 7 per cent. of phosphoric acid, and from 6 to 10 per cent. of potash.

Wood-ashes which contain both lime and potash may be applied broadcast to the land at the rate of from 25 to 30 bushels per acre. Soils that are deficient in lime should receive dressings of fresh burned lime every four or five years at the rate of from 1,000 to 2,000 lb. per acre. In India tank or channel silt is much valued as a ground-nut manure. It is applied to the land once in about four years at the rate of from 50 to 100 cart-loads per acre. This silt has been found on examination to consist of about 22 per cent. of lime and about 70 per cent. of fine sand.

Sowing.—Care should be taken to use only good seed for planting. With native cultivators it frequently happens that only the unsaleable nuts of poor quality are available, and to this is probably due the degenerate crops and poor yields which obtain in some localities.

Either the whole "nuts" or the decorticated seeds may be used for planting. If the former are used the germination of the seed is delayed until the shell has decayed and permitted the young plant to escape. This takes but a few days in tropical countries where decay is rapid, but in dryer and cooler regions the use of whole nuts for planting causes an appreciable delay in the germination of the seed. Where decorticated seeds are used the pods should be opened by hand and care taken not to injure the delicate seed coat, as injury or bruises are liable to be followed by decay after the seed is planted. One of the advantages of shelled seed is the opportunity afforded during the shelling for eliminating any that are defective, hence the better "stands" that usually result when decorticated seeds are sown. The seed to be used for planting should not be shelled until a short time before it is required for use, or it is liable to lose its power of germination.

Machines have now been devised for planting ground-nuts, and are in common use in the United States. They are similar in structure to those used for planting cotton seed, and effect a great saving in labour.

The seed is usually sown in straight rows or drills, and where

hand planting is practised the land should be first marked out. This is easily done by means of an improvised harrow with teeth set at the required distance. The seeds may be dropped in the lines made by the harrow at regular intervals and covered with soil by the foot. The depth at which the seeds should be planted varies from 1 to 1½ or 2 inches, according to the character of soil. The heavier the soil the shallower should be the planting. The distance between the rows depends upon the variety grown, and local conditions. A common distance for planting in the United States is 36 inches between the rows and 12 inches from plant to plant, while in the Madras Presidency the seeds are sown about 5 inches apart, each way. If planted too thickly the branches overspread each other, and many of the stalks fail to reach the ground, and in consequence do not form pods. Experience of the local conditions, and the habit of the variety grown, is the only safe guide on this point, but not less than 1 foot or more than 3 feet between the rows should be given. Should serious gaps appear in the rows a supplementary sowing will be necessary, and this should be carried out as soon as possible after the plants from the first sowing appear above the ground.

After Treatment.—As soon as the young plants have attained a height of from 1 to 2 inches, the soil between them should be hoed. Where machines are available the horse-hoe or cultivator can be used for this purpose, and much hand labour saved thereby. Frequent hoeings are necessary, as this operation not only checks the growth of weeds and prevents the evaporation of moisture from the soil, but also produces the necessary fine surface tilth. The number of hoeings necessary will depend upon the character of the soil and the rate at which the weeds grow, but as soon as the haulms have developed sufficiently to cover the soil this work may cease. In making the later hoeings the soil should be drawn towards the plants, and this should be carefully done or the first-formed pods are liable to be injured.

Harvesting the Crop.—In tropical countries the stems begin to fade as soon as the rains have ceased and the dry weather has set in. This is an indication that the plants are ready for harvesting. It is advisable to lift the plants as soon as the stems

show sign of fading, as then the pods are firmly attached to the stem and are not so liable to be detached during the process of lifting. In the case of compact soils, which retain moisture for a considerable time, a longer period for ripening is required. Any nuts that become detached should be gleaned by women and children, or hogs may be turned into the field to consume those that are left in the soil. The ripening season is a critical period, as if rain falls before the crop is lifted, after a spell of dry weather, the seeds in the first-formed pods are liable to start into growth, and are then of little or no value as oil-seeds. The stems, if lifted and carefully dried as soon as the plants begin to fade, form an excellent fodder (see p. 172 for analyses).

There are various methods of harvesting the crop. Native cultivators either use a large hoe with which to lift the plants, or dig them up with a fork. On irrigated land in India, harvesting is sometimes effected by flooding the land. This is carried out by first removing the stems and allowing the land to become quite dry in order to thoroughly ripen the pods. The land is then moistened and ploughed several times to expose the pods, and flooded with water. The ripe pods float and are drifted by the wind, or swept by a broom made of twigs into one corner of the field, where they are collected, dried and winnowed.

The Chinese cultivator harvests his crop very thoroughly. He lifts each plant with a spade-like implement and throws it, together with the soil, which adheres to the roots, into a bamboo sieve, which is shaken by another operator. The soil passes through the meshes of the sieve and the pods are retained. Any chance pods that escape are gleaned, or poultry and pigs are turned into the fields to feed on them.

In temperate countries the plants should be lifted as soon as they are found to be well set with pods and before autumn frosts occur. In the United States several mechanical appliances are in use for lifting ground-nuts. The simplest is the ordinary turning plough from which the mould-board is removed. This is run along the rows, and the roots of the plants severed; the stems are then lifted by hand, shaken free from soil and left on the ground to dry. From 5 to 7 acres per day may be lifted in this manner by a driver with a pair of horses

followed by a gang of from eight to ten men. The ordinary machine potato-digger is also suitable for lifting ground-nuts. This machine not only severs the roots, but lifts the plants from the soil and leaves them on the surface of the land. One man with two or three horses and a machine of this type can lift from 8 to 12 acres per day. After being lifted the stems are collected into small heaps and left to dry for several days or weeks, according to local climatic conditions. If required for fodder the stems should be protected from rain by covering the tops of the heaps with straw or grass. The pods are liable to become discoloured if exposed to rain or heavy dews.

In the United States great care is taken to secure a good fodder from the stems as well as to thoroughly mature the nuts. The following is the method of drying and curing usually practised:—The stems are left for a few hours after lifting, and are then collected and formed into a number of small heaps, each arranged round a central stake or pole, which is about 7 feet long and firmly fixed in the ground. To the base of the pole, and a few inches from the ground, two pieces of wood are nailed crosswise on each other and at right angles to the pole. The object of the cross pieces is to prevent the stems from coming in contact with the soil. Successive layers of stems are built up round the pole until the top is reached. The pods are kept towards the centre of the heap and the leaves to the outside. A slope is given to the stems in order to throw off rain, and the tops of the heaps are covered with straw, grass, or weeds for the same purpose. The shocks are sometimes arranged in single rows in the field, or collected into groups, or stacked close together in an enclosure.

This method of stacking in small heaps permits an abundance of air to circulate around the stems, and prevents mildew, which is liable to attack the somewhat fleshy haulms if stacked in large heaps or in barns.

Picking the "Nuts."—The separation of the pods from the stems is usually effected by hand. This is a tedious and expensive method, but, as it is not laborious, women and children engage in the operation. The pods should not be picked until they have become quite dry and the seeds firm and nutty, and empty or shrunken pods should be allowed to remain on the

stems. During wet or foggy weather the stacks should not be opened, as exposure to wet discolours the pods, and the haulms would be spoiled for use as fodder. Threshing the stems with a stick is a more expeditious method of removing the pods, but by this practice many of the pods get damaged and the stems are rendered less valuable as fodder, as many of the leaves are broken off. Provided the stems are well set with pods, a good picker can handle from 8 to 12 bushels per day. Machines are now available for threshing ground-nuts, but they are liable to crush or burst the pods, and the seeds in open or "oyster-mouthed" pods do not keep well, and soon become rancid. Improved types of threshing-machines are, however, being produced, and in the near future this work will possibly be done as well by machinery as by hand.

After being plucked the pods should be spread out to dry, and then put into sacks or stored in granaries protected from rain. In the tropics, where a long period of dry weather can be depended upon, they are stored in large heaps prior to being shipped; and in the French colonies on the West Coast of Africa improvised granaries of wicker-work are built for the purpose of storing them.

In the United States the pods are treated in a cleaning factory before being put on the market. Here they undergo various processes which remove all dirt from the pods, and finally sort them into grades.

After the removal of the pods the small heaps of dried stems may be made into larger stacks and used as fodder.

Yield.—The yield varies with local conditions and the variety grown, and more especially with the amount of cultivation the plants receive. With proper methods of cultivation the yield should average about 60 bushels per acre, and yields of 100 to 160 bushels per acre have been recorded. Owing to the continuous cropping of the same land with ground-nuts, areas in the State of Virginia which formerly yielded an average crop of from 50 to 75 bushels (= 1,200 to 1,800 lb.) per acre, now yield only about 24 bushels. In the Madras Presidency the yield may range from 700 to 5,000 lb. per acre. The out-turn for the season 1908 varied from 180 to 720 lb. on unirrigated land to 3,600 lb. on irrigated land. In the Gambia the yield is from 50

to 60 bushels per acre, and in Senegal it is reported to be from 1,500 to 1,800 kilogrammes per hectare. At Port Darwin, in North Australia, yields of 3,024 lb. per acre have been recorded, and as much as 4,000 lb. per acre in Barbados.

The yield of fodder per acre averages about 1 ton, but may be as much as $1\frac{1}{2}$ to 2 tons according to the soil and the season.

Varieties.

As already stated, the numerous varieties of ground-nut may be grouped into two general classes, namely, the "erect" or "bunched" varieties, which have more or less upright stems with the pods clustered at the base, and the "running" forms which have straggling or semi-prostrate branches that bear pods at intervals along their whole length. Intermediate forms between these two types are common. In nearly every country where ground-nuts have been cultivated for a long period of time, varieties peculiar to the locality have been produced. From this it would appear that by following a systematic course of seed-selection, it would be possible to obtain varieties suited to particular localities, to special soils or peculiar climatic conditions. Already much has been done to improve the yields in countries where they had deteriorated, by introducing new varieties or seed obtained from other localities. Where fungoid pests are prevalent it seems particularly advisable to follow this course.

In Senegal the varieties in common cultivation are semi-prostrate in habit, and the pods are small, and usually contain two seeds. Varieties producing large pods that are two-seeded, and others that are small and contain only one seed, are, however, frequently met with. Consignments of pods from Saloum frequently contain a quantity of both these last-named forms. Less widely grown in Senegal is a small two-seeded variety which has erect stems, and reaches maturity at least a month earlier than the common forms. In the Niger Valley five varieties are distinguished; one of these is of the "erect" type and the remainder of the "running" class. Besides the two-seeded Senegal type, a large quantity of three-seeded pods are produced in Casamance, as well as very large two-seeded pods, which are borne by the so-called "elephant"

variety. On the Guinea coast similar varieties are grown, and in addition two local forms are met with, one of which has erect and the other spreading branches. In the British Possessions on the West Coast varieties similar to those which obtain in French territory are cultivated. The Egyptian variety is prostrate in habit, and produces two-seeded pods of the Senegal type. In South Africa it is stated (*Farmer's Bulletin, Transvaal*, No. 15), that the following varieties are at present in cultivation: (1) the "*Kaffir*," a small-podded form with small seeds, that does not harvest well, owing to the brittle nature of the stalks: (2) the *Mauritius* variety; this is not altogether satisfactory, as it appears to require a warmer climate, and (3) the *Virginia Bunch* (see p. 166). On the Mozambique coast a prostrate variety is grown which produces small two-seeded pods, and a more common form that produces pods containing three seeds. Good results have been obtained in India by cultivating this kind. Several other races are grown in India, where they are spoken of collectively as the "ordinary" or "indigenous" varieties. They are of semi-prostrate habit, and usually produce small two-seeded pods. There are said to be two forms in cultivation in Ceylon and two in the Malay Peninsula. The type cultivated in Java belongs to the erect-growing class, with the two-seeded pods produced in clusters or bunches at the base of the stems. The pods of this form are peculiar in that they have but a slight constriction between the seeds, which is such a marked feature in the pods of other varieties. Another form grown in Java has longer pods that contain from three to four seeds. Samples of Chinese ground-nuts received at the Imperial Institute from Hong-Kong, show that at least two forms are cultivated in China; one of these produces a fairly large pod containing two seeds, and the other a small one- to two-seeded pod with the reticulations strongly marked on the surface.

At the Japan-British Exhibition in London (1910) numerous samples of ground-nuts grown in Japan are exhibited. The pods are of very large size, usually two-seeded, and with only slight reticulations on the outer surface. They are used in Japan chiefly as food. In the section devoted to the products of Formosa at the same exhibition are samples of two varieties; one of these consists of two-seeded pods of medium

size, and the other of very thin elongated pods, strongly reticulated on the surface, containing from 2 to 3 seeds. These are extensively cultivated in Formosa, particularly in sandy places along the sea-coast. The area under ground-nuts in Formosa for 1908 was 52,211 acres, and the output 1,277,900 bushels.

Beattie records (*Farmer's Bulletin*, U.S.A., No. 356) some five or six varieties as being in common cultivation in the United States, viz.:—

Virginia Bunch.—An erect-growing kind of rather dwarf habit, with large two-seeded pods, produced in bunches at the bases of the stems.

Virginia Runner.—A strong-growing variety, with running stems and two-seeded pods, that are similar in appearance to those named above, but are produced along the stem instead of at the base.

North Carolina.—A similar variety to the foregoing, but less vigorous in habit and with smaller pods.

Spanish.—An erect variety of vigorous habit of growth with small two-seeded pods produced at the bases of the stems.

Tennessee Red.—A small-podded variety similar to the Spanish but with longer pods that often contain from five to six seeds. Owing to its colour this form is more adapted for stock-feeding than for edible purposes or marketing.

Dixie Giant.—A very large-podded variety that does not yield well, and is only adapted to warm countries, as it requires a long season to mature.

Disease and Pests.

Few pests appear to attack well-cultivated crops of ground-nuts when in the field. Rodents and some birds will attack the freshly-planted seed, and the tender sprouts of the young plants are sometimes also eaten. In Ceylon and South India the most serious insect pest is a small moth (*Anacampsis nerteria*, Meyr.) which deposits its eggs on the leaves of the plant. When the larvæ hatch out they burrow into the leaf-tissue, which quickly withers and turns black. The whole life-cycle of this moth is completed in about a month, and as ground-nut plants are always available either on irrigated or rain-watered land, brood succeeds brood throughout the year. Dry weather favours this

pest, and owing to its habit of burrowing in the leaf-tissues, spraying is not of much use as a remedy. In order to keep the insect in check, the use of light traps is recommended, as large numbers of the moths are attracted by a bright light at night.

Locusts sometimes eat off the foliage, and so reduce considerably the yield of pods. Termites also prove troublesome in some cases. In the United States the presence of a root aphis has been detected, but so far it seems to have done little harm to the crop.

A leaf-spot fungus occasionally attacks the leaves, particularly during a wet spring or on badly drained land. This can be kept in check by spraying with Bordeaux mixture in well-drained soils, but is more difficult to eradicate on wet land. Its presence on the leaves not only reduces the crop of pods, but also spoils the haulms for use as hay.

The "tikka" disease in India is also caused by a fungus which forms quantities of spores on the under-surface of the leaves of the plant, and in consequence is difficult to treat by spraying as the leaves are close to the ground. As the early maturing varieties appear to suffer less than the later kinds, it is advisable to grow the former where this pest is prevalent.

Weevils are liable to attack ground-nuts when stored in granaries, but can do little damage to sound pods. The seeds in broken pods, or decorticated seeds, however, suffer considerably from their ravages.

UTILISATION.

Ground-nuts are largely used in the countries of origin as human food, either in the raw state, or roasted. The native races also use them in soups, and mixed with millet and rice in the preparation of various foods. The demand for roasted nuts in America is so great that in 1907, after the very large local crop had been consumed, some $73,631 worth of nuts were imported from Marseilles. Besides being roasted, various other methods of preparing the "nuts" as food are adopted in the United States: they are blanched and salted; mixed with syrup they are made into candies either alone or in combination with pop-corn and puffed rice; and ground-nut meal is made into various confections. A recent development is the manufacture

of "pea-nut butter." This is made by roasting the "nuts" and removing the thin seed coat; the kernels are then ground up to form a fine paste and salted to taste. The Spanish variety is largely used for this purpose; and the product is put up into bottles or tins, and used largely for furnishing camping and cruising supplies. A small quantity of selected ground-nuts is used in England in confectionery as a substitute for almonds. In India they are extensively eaten roasted, and are now made into sweetmeats, being mixed with palmyra palm or sugar-cane jaggery.

By far the greater part of the world's production of ground-nuts is used for the expression of oil. For a great many years Marseilles has been the chief centre of this industry, and large quantities of ground-nuts annually reach that port from various parts of the world. The total import of ground-nuts into Marseilles for the year 1907 is given as 236,523 tons. Other less important centres of this industry are at Bordeaux, Dunkirk, Rouen, Valencia, Trieste, Delft, Hamburg, Berlin and Riga. A certain amount of ground-nut oil is also expressed in India, China, Java and Japan.

Preparation of Ground-nut Oil.

In most countries where ground-nuts are grown, oil is prepared from them by means of crude native wedge presses, or pestle and mortar mills; such oil is, however, only employed for local use. The question of preparing ground-nut oil on a large scale in countries of production by modern machinery is worth some consideration. Local extraction has the advantage that oil can be prepared from nuts in a fresh condition, freight charges would be lessened, and the residual cake would become available for local use. On the other hand it is uncertain whether oil prepared locally would be equal in value to that obtained in European oil-mills, where expert supervision and highly skilled labour are available. It seems desirable, however, to give here a short description of machinery and processes for the extraction of the oil, with special reference to plant suitable for use in tropical countries with native labour.

In the preparation of ground-nut oil the first step is the removal of the outer husk of the nut, though sometimes un-

shelled nuts are directly expressed for oil. This is often effected by hand, especially where the labour of native women and children is available; but small machines worked by hand, and suitable for use in the Colonies are obtainable. The general principle upon which these machines work is the breaking of the husks between rollers, set at such a distance as to effect this without crushing the kernels; the husks, and as much as possible of the red "skin" of the kernel are then removed by means of a blast of air. The husks are generally blown to the engine and used as fuel, but are sometimes mixed with meal and made into cakes, whilst the red skins are added to refuse meal and expressed, but they are said to impart an unpleasant acrid taste to the residual cake.

The cleaned kernels are ground between rollers and then submitted to expression in hydraulic presses, and as they contain a high percentage of oil, from 43 to 45 or even 50 per cent. they are generally pressed two or three times in succession.

The first pressing takes place at the ordinary temperature, and, on account of the pasty nature of the ground mass, which causes it to ooze through the press-bags or cloths, which are generally employed, the most modern installations employ "cage" or "clodding" presses (*i.e.* presses composed of a perforated metal cylinder, or of a circle of stout, flat, metal staves, surrounded by strong metal rings) in which the ground meal is packed between metal plates, the use of press-cloths or bags being unnecessary. By this first expression in the cold, kernels of good quality may yield as much as 30 per cent. of pale-coloured oil, having an agreeable nut-like flavour; this "cold-drawn" oil is known as "huile surfine" de Rufisque, Gambia, etc., according to the origin of the nuts used in its preparation, and is largely employed for edible purposes.

This first cake is then broken up, moistened, and warmed in steam "kettles" to a temperature of 30 to 32° C., and submitted to a second expression, when a further 6 or 8 per cent. of oil inferior in quality to the first, but still suitable for edible use, is obtained. In some cases this second expression is carried out at ordinary temperature. In cases where a third expression is made, the temperature is increased to about 48 to 50° C., and

from 5 to 7 per cent. more oil is obtained, which is unfit for edible use, and is chiefly made into soap. The second and third expressions are usually made in open Anglo-American or Marseilles presses, which employ cloths or bags to hold the cake.

The following are the approximate yields obtained in oil-mills from different kinds of ground nuts:—

Kind.	From undecorticated nuts. *Per cent.*	From decorticated nuts. *Per cent.*
Rufisque	31 to 31·5	45 to 46
Gambia	30 to 31	—
Egypt	31·5	—
Mozambique	—	42 to 45
Bombay	—	37 to 38
Coromandel	—	36 to 37

Generally speaking it is only from the best grades of ground-nuts, *e.g.* Rufisque, Cayor, Sine, Gambia, etc., shipped in their husks, that the finest qualities of oil, suitable for edible purposes can be prepared; such grades as are shipped in a decorticated condition, *e.g.* Bombay, Coromandel and Mozambique, undergo changes, which render the oils obtained from them of unpleasant taste, whilst the cakes are also slightly inferior.

Characters of Ground-nut Oil.

Ground-nut oil is a non-drying oil, having the following average constants (Lewkowitsch, *Oils, Fats, and Waxes*, vol. ii., p. 249).

Specific gravity at $\frac{15·5}{15·5}$	0·925
Saponification value	185·6 to 197
Iodine value *per cent.*	84·6 to 105
Reichert-Meissl value	0·0 to 1·6
Hehner value *per cent.*	94·8 to 95·8
Titer test °C.	28·1° to 29·2°

The principal uses of the oil are as an edible oil, and for soap-making; it is also used for lubricating, as an illuminating oil, and for oiling wool. Only the cold-drawn oil from high-grade nuts is suitable for edible use, such oil being employed

alone or as a substitute for olive oil or for blending with olive oil of harsh flavour. Ground-nut oil is also used in the manufacture of margarine and butter substitutes, and for preserving sardines. Oil for edible use is frequently decolorised by means of fuller's earth or charcoal.

Ground-nut Cake.

The residual cake after expression of the oil forms a valuable feeding stuff for cattle and other farm animals. The following are typical analyses (Smetham, *Ann. J. Royal Lancashire Agric. Soc.*, 1909) of the cake compared with other feeding cakes in common use :—

	Ground-nut cake.		Cotton-seed cake.		Linseed cake.	Soya bean cake.
	Decorticated.	Undecorticated.	Decorticated.	Undecorticated.		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	10·6	11·6	9·00	13·75	11·16	12·7
Ash	5·95	5·70	7·10	4·60	5·20	5·05
Oil	7·73	7·17	11·38	6·56	9·50	11·07
Protein	49·31	28·50	43·78	24·62	29·50	38·82
Carbohydrates	21·71	28·06	23·56	29·28	35·54	26·51
Crude fibre	4·70	18·97	5·18	21·19	9·10	5·85

As the result of cattle-feeding experiments made at the Woburn Experimental Farm, it is stated that ground-nut cake is about equal in feeding value to beans (*J. Ry. Ag. Soc. Eng.* Ser. 2, 1892, 727).

Damaged and mouldy ground-nut cake finds an extensive use as a fertiliser, and is so used in the south of France, and also in India, Ceylon, and other countries.

The husks are generally burnt and the ashes used as a fertiliser; but the husks are sometimes used as a litter for cattle, for mixing with ground-nut meal, or as an absorbent medium in making cattle foods, with molasses as a basis.

Ground-nut Hay.

The ground-nut plants, after removal of the nuts, are either employed as a green manure, fed to animals in a fresh state, or converted into hay and stored for use as a fodder. For the latter purpose they must be slowly dried in order that the leaves may not drop off.

The following analyses, with the exception of that for meadow hay, are taken from *Farmer's Bulletins* Nos. 25 and 356 of the United States Department of Agriculture, and show the relative values of various ground-nut products for feeding stock or as fertilisers.

Ground-nut.	Moisture.	Calculated on the dry substance.					
		Ash.	Protein.	Oil.	Crude fibre.	Carbo-hydrates.	Total Nitrogen.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Whole plant	—	—	18·40	21·50	—	40·10	—
Leaves and stems, green	77·10	7·05	16·00	4·27	20·11	50·01	2·56
Leaves and stems cut before flowering	31·20	10·64	12·63	6·07	22·32	48·34	2·02
Leaves and stems cut after ripening of fruit	31·91	12·08	10·81	5·02	32·28	39·81	1·73
Hay	7·83	17·04	11·75	1·84	22·11	46·95	1·88
Husks	12·94	3·39	7·22	2·68	67·29	19·42	1·17
Clover hay	14·30	7·47	12·84	2·11	29·27	48·31	—
Meadow hay (good quality)	15·0	7·0	11·7	2·20	21·9	42·2	—
Alfalfa	6·95	7·49	16·48	2·03	31·38	42·62	—

Ground-nut hay is extensively used for feeding farm animals, and it is customary in parts of the United States to raise crops of ground-nuts primarily for use in feeding stock, the whole plant being utilised in this way, although it is more general to remove all first-class nuts, and to convert the stems and leaves into hay, whilst pigs are turned into the fields to eat up any unharvested nuts remaining in the soil.

THE CULTIVATION AND PREPARATION OF "BRIGHT" TOBACCOS.

THE tobaccos of commerce may be roughly divided into three great groups, viz.: Cigar tobaccos, "Virginian" tobaccos and Levantine or "Turkish" tobaccos. Each of these groups includes many sub-groups, and these again many varieties, each showing distinctive characteristics in type of leaf and in the aroma and flavour of the smoke produced on combustion.

Almost each variety of tobacco requires peculiar treatment,

both as regards its cultivation and preparation, so that it is impossible to lay down general rules that will be of any practical value for all the groups.

In the present article it is proposed to deal only with "bright" pipe and cigarette tobaccos, which form a sub-group of what are generally known in the United Kingdom as "Virginian" tobaccos. These "bright" tobaccos are produced typically in the United States, though much success has attended their production in recent years in Rhodesia, Nyasaland, the Transvaal and elsewhere. Their chief peculiarity lies in their colour, which should be a bright yellow inclining to orange. It is possible by appropriate cultivation and curing to produce "bright" tobaccos, starting with almost any kind of tobacco seed, and very promising samples of bright tobaccos have been received at the Imperial Institute, raised originally from seed of such typical cigar-leaf tobaccos as Sumatra, Cuba, Florida-Sumatra and Honduras. It is better, however, in starting the cultivation of bright tobaccos to use seed of one of the recognised varieties, such as "Hester," "Conqueror," "White Stem Orinoco" or "Yellow Pryor." There are, of course, numerous other named-varieties of this type, and the above are merely mentioned as examples of kinds which have given promising results under trial in Nyasaland or elsewhere. At first a number of varieties should be grown experimentally, and the best selected for cultivation.

For the cultivation of this class of tobacco a light sandy soil is necessary, and it should be of fair depth and contain a fair quantity of lime, though an excess of the latter will interfere with the burning quality of the tobacco. According to Odlum, the typical "bright" tobacco soils of Virginia and North and South Carolina consist of sand of varying density with usually not more than 8 to 10 per cent. of clay, and are generally underlaid by a red or yellow clay subsoil at a depth of about 1 foot. This rule as to the lightness of the soil for bright tobacco is, however, not invariably applicable, and Boyd states (*Nyasaland Handbook*, 1909, p. 178) that in Nyasaland satisfactory "bright" tobaccos can be grown on dark loam or heavy soil in normal seasons.

In selecting a tobacco for cultivation attention must be given

to the matter of climate. Tropical countries are, on the whole, best suited to the production of cigar tobacco, and the warmer parts of the temperature zone to the cultivation of pipe tobaccos. In conformity with this general rule, it has been found in Nyasaland that "bright" tobaccos do best in the Upland districts, and this will probably also prove true of this type of tobacco in other tropical countries.

CULTIVATION.

Formation of Nurseries.—In preparing a seed-bed for tobacco, about 50 square yards should be allowed for every ounce of seed. Heavy, well-formed seed should be used, and a simple winnowing arrangement can easily be devised to remove light and imperfect seed. Before sowing the seed its germinating power should be tested in the following manner:—A hundred seeds are counted out and placed between two pieces of moist blotting-paper. The paper is kept between two plates and at a temperature of from 70°–80° Fahr. for ten days, at the end of which time the percentage of good seed is determined by counting the number which have germinated. On the basis of this determination any deficiency in germinating power should be made up by sowing a larger quantity of seed.

It is sometimes advisable to burn out the site of the proposed nursery before sowing seed in order to destroy the seeds of grass and weeds and the larvæ of insects, which may later on damage the young plants. For this purpose the bed is covered with poles in order to keep the burning wood off the soil and admit air. Upon these poles the wood or fuel is piled and the fire started. A slow fire is then continued long enough to convert all the moisture in the top three or four inches of soil into steam. After the bed has been thoroughly sterilised in this manner, the soil is broken up to a depth of two to three inches, and the ashes from the fuel thoroughly worked in.

The seed is sown about sixty days before planting time, and is previously mixed with ashes or fine meal to facilitate uniform sowing. After sowing, the soil is lightly raked over, the surface formed, and then sprinkled with water.

The plant-bed should be covered with light cloth or muslin

stretched over a framework about six inches above the bed. The soil should be kept moist but not wet, and during the last month in the plant-bed it is advisable to sprinkle from time to time with liquid manure. Just before transplanting, the seedlings should be "hardened off" by gradually lessening the shade.

Preparation of the Soil.—The soil in the site selected for the plantation should be dug or ploughed deeply and thoroughly at least twice, and the surface brought to as fine a tilth as possible. Either "ridge" or "level" cultivation may be adopted, the former being given the preference if the soil is excessively moist.

Transplanting, etc.—The young plants are usually ready for transplanting in about sixty days. In removing them from the soil in the seed-bed care must be taken to disturb the roots as little as possible, and it is a good plan to soak the bed thoroughly first in order to prevent breakage.

When transferred from the seed-bed to the field the plants should be set out in rows at a distance of about 3 feet, so that cultivation between the rows is possible. As a rule, the distance between plants may be taken as 18 inches to 2 feet, but the actual spacing will depend on the quality of the soil. Too wide planting is to be avoided, as it generally results in the production of a coarse leaf of inferior value. The soil must be kept moist and free from weeds. Hoeing is frequently necessary, and a mulch should be kept on the surface, so that it does not become hard or crusted. Moisture is thus retained, so that except in very dry districts little or no irrigation is required in a normal season.

Cultivation should be carried out whenever the soil begins to harden or crust over, and if possible it should be done immediately after every shower of rain. Thorough cultivation is of extreme importance with tobacco, and the plants respond readily to such treatment.

The soil should be worked a little round the plant at each cultivation, as the ridges thus formed effectively prevent surface water from gathering round the plant during heavy rain. They also assist quick growth, and a lighter leaf is thus produced.

Topping, Priming and Suckering.—If seed is allowed to form in this class of tobacco, the leaves produced are small and of poor quality. It is necessary therefore to remove the terminal

bud from each plant at a certain stage of growth. The selection of the stage at which the bud is to be removed is a very important matter, and on this point experience alone is useful. The stage at which topping is done determines the number of leaves to be carried by the mature plant, so that obviously strong well-advanced plants may be "topped higher" than weakly backward ones, and experience alone enables a decision to be arrived at in each case, since the conditions vary even in different seasons in the same country. Most planters also remove several of the ground leaves from the base of each plant, since these are usually poor and dirty and interfere with cultivation. This operation known as "priming" may be performed any time after the plants are about 10 inches high. If, after "topping" a plant, it is found that this operation has been delayed too long and too many leaves have been left on, the mistake may be partially remedied by "priming" a few more leaves. One of the first effects of topping is to cause "suckers" to spring out from the axils of the leaves, and these should be removed as soon as they appear.

A few plants should always be allowed to seed, and in selecting these the best plants, which produce a terminal bud early should be chosen as a rule, unless for any reason a late ripening tobacco is desired. From the selected plants the greater part of the leaves and the suckers should be removed. When the blossoms form they should be pollinated by hand, and then covered with paper bags to prevent accidental cross-fertilisation from unselected plants. It will be necessary to collect selected seed in this way until a desirable variety worth perpetuation has been established, and once this has been accomplished the planter should produce his own seed, and in this way by careful selection continually improve his stock.

Harvesting.—Ripening is greatly hastened by the operations of topping and suckering. Ripe leaves can be recognised by their changing to a lighter shade of green and the development of yellow spots. They are also rough to the touch and crack easily when folded between the fingers. When ripe the leaves are ready for harvesting. Pipe tobaccos should always be harvested too ripe rather than too green. Picking should not be started until twenty-four hours after rain has fallen. If possible, bright

sunny days should be chosen for cutting, and in countries where the seasons are well defined, growers should so arrange the time of planting as to allow the crop to ripen and be harvested before or after the rainy season.

Tobacco which is to be flue-cured should be harvested leaf by leaf, for when the middle leaves are at the proper stage of ripeness, the lower leaves are over-ripe and the top leaves still green. When the leaves are thus "primed" they are at once placed in baskets and taken to the "curing" barn. At the barn the leaves are strung in pairs on ropes, poles or bamboos at distances of 6 to 8 inches apart.

Curing.—It is possible to cure "bright" tobaccos in the open air, and at first this method was in general use, but it is as a rule too uncertain to be relied on, and now wherever bright tobaccos are produced in quantity flue-curing is resorted to. The object of flue-curing tobacco is to start a slight fermentation in the leaf through the application of a gentle heat until the tobacco "yellows." After "yellowing" the temperature is raised to dry out the sap and fix the colour.

The fires, which are generally of wood, are placed in small brick furnaces outside the building, and hot air is carried through the barn and under the tobacco by means of large sheet-iron flues.

Flue-curing Barns.—The barns are generally not large, being of a size that can be filled by a few people in a very short time. The most suitable size is about 16 by 20 feet and 18 to 20 feet high. In the United States they are usually constructed of pine logs dovetailed into each other, but any suitable material can be used. In the roof, or in the gable end, there are ventilators which can be opened to allow of the escape of hot air and moisture, and at the ground level there are several small ventilators that can be opened at will for the entrance of cold air. All the ventilators must be so constructed that they can be opened or shut from the ground. At the end of the building a small shed is erected under which are built brick arches or furnaces. From each of these, which are built about a third of their length into the barn, runs a 12-inch flue, which passes along the floor to the opposite end of the barn and then returns at a higher elevation, carrying the smoke to the open air. A thermometer should be

hung in the centre of the barn, and in such a position that it may be easily read from the door. The tobacco leaves or plants are hung in pairs on a framework of poles running lengthwise through the barn, the lowest tiers being about 8 feet from the ground.

Filling the Barn.—Tobacco may be cured on the "stalk," or, better, on the single-leaf system. In the latter case a greater quantity may be placed in the barn, and each curing will be of much the same ripeness and grade throughout. The stalk system requires more time in the curing but less in the harvesting.

When stacking the barns with tobacco the top tiers should first be filled, and then the lower tiers in succession until the barn is full. All preparations must be made beforehand, so that there is no delay in filling. Equal treatment of the tobacco is thus ensured, and the curing can start at once. If some of the tobacco leaves are "wilted" whilst others are still fresh, it is impossible to obtain a uniform bright colour. As soon as the barn is filled the fire is started, and from that time till the end of the process, which occupies four or five days, it is not allowed to die down or go out. The curing process may be divided into three stages. The temperatures given are on the Fahrenheit scale.

"*Yellowing*" *or* "*Wilting.*"—The interior of the barn is kept at a temperature of 90° for from eighteen to twenty hours, or until the tobacco has reached the proper colour and lost a portion of its moisture. If after that time the colour has not commenced to change, moisture must be introduced by throwing water over the floor and on the flues, thereby creating a supply of steam. Some planters hasten the "wilting" by keeping the temperature at 90° for three hours only and then rapidly increasing to 120°, and, as soon as that point is reached, reducing the temperature to 90°, at which it is maintained for from six to eight hours.

In Nyasaland, Boyd (*loc. cit.*, p. 180) recommends the following procedure: 90° for twelve to fifteen hours, then 95° during six to eight hours followed by 100° during a further six to eight hours, and 105° for a third like period, the temperature being finally kept at 110° during from twelve to fifteen hours, until the tobacco is yellow and in drying condition.

If after twenty-four hours the leaf does not "yellow," then in

all probability the desired colour will not be obtained, and the idea of producing a "bright" tobacco should be abandoned and air-curing resorted to. Should the leaves colour too rapidly and moisture appear on the leaf, ventilation is required, and the door of the barn and the ventilators should be thrown open.

During the process of "yellowing" certain chemical changes take place in the leaf; there is a destruction of chlorophyll and starch, and the leaves lose about 80 per cent. of their weight.

Fixing the Colour.—The second stage consists in fixing the colour, probably by destruction of certain enzymes (unorganised ferments) which would otherwise oxidise the cell contents and produce a brown or red colour. This is done by increasing the temperature, starting at 100° and rising to 120°, and driving off the moisture. A temperature of 100° is maintained for about six hours and then raised at the rate of 2° per hour to 110°. This temperature is kept for three hours when a further increase of 3° per hour is made up to 120°, at which it is maintained until the tobacco is dry. This part of the process should occupy about twenty hours.

"*Killing.*"—In this part of the process, which follows immediately after the colour is fixed, the temperature is gradually raised from 120° to 135° or 140° during about forty-eight hours, at the end of which time the leaf is so dry that it will crumble to powder in the hand. If the tobacco is cured on the stalk, a fourth stage is necessary, and is known as "killing the stalk," the object being to prevent the sap from the stalk passing back into the leaves on cooling and forming red patches in the region of the veins. For this purpose the temperature is gradually increased at a regular rate per hour until it reaches 160° to 175° and the stalk is thoroughly dry. During the whole process it is of the utmost importance that the temperature should not be raised too quickly, otherwise the sap is dried into the leaf, and this is shown by the formation of red blotches or spots. Too high a temperature will also "scorch" the leaf.

Handling Yellow Tobacco after Curing.—When the tobacco is to be taken down, the barn is left open during the preceding night or longer, so that the leaf may absorb sufficient moisture to bring it into condition for handling. If the leaf can be folded

in the hand without breaking the stem, it is in proper conditi
to be taken down without injury.

When taken down the tobacco is carried to the packing-hou
where it is "bulked." The bulks are built up with the "butt
(lower ends of leaves) pointing outwards, and the "tips" ov
lapping in the centre. The heaps are usually made 4 to 5 fe
high, and to avoid injury from mould they should be taken do
at the end of a week and rebuilt if necessary. This treatme
generally improves the colour of the leaf, and especially assi
in the removal of any green patches still remaining. Each bat
cured should be bulked by itself. When the bulking is over t
leaves are carefully graded, *i.e.* assorted according to their si
colour and freedom from holes or spots. The grading of tobac
for export purposes when completely carried out is a ve
difficult matter, and requires great experience of market co
ditions; but elementary sorting on the lines just indicated
always sufficient until the industry has become large enough
warrant the installation of a central buying and grading facto
at which this operation can be carried out under the supervisi
of a grading expert. Such a factory as a rule also undertal
the packing of the tobacco for export.

The tobacco is finally made into "hands" of about fo
leaves, tied together at the base by a tobacco leaf, and th
hands are usually packed in hogsheads or barrels for export.

GENERAL NOTES.

New Series of Selected Reports from the Imperial Institute. *Part III.* **Foodstuffs.** The third part of this series of selected reports (this *Bulletin*, 1909, 7. 200) has just been issued in the Miscellaneous Series of Colonial Reports (Cd. 5137). It deals with "Foodstuffs" and gives detailed statistics of the trade of the United Kingdom in imported food grains, and contains a series of reports and memoranda prepared by the Scientific and Technical Department of the Imperial Institute on samples of barley, oats, maize, rice, millets, lentils, beans, peas, etc., received in recent years for examination from British Colonies and Dependencies. A large number of reports on the composition and value of teas grown in Natal, Nyasaland and Hong Kong and of coffees cultivated in India, Trinidad and East Africa are also given. Among other products dealt with are cocoas from Uganda, Trinidad, British

Honduras and the Gold Coast. In the last-mentioned country the production of cocoa has reached large dimensions, and the chief obstacle to its further development is the faulty system of preparation adopted by the natives. In the reports now printed information is afforded as to the efforts that are being made to improve the quality of this product.

The Relative Value of the Principal Tanning Materials.—In a paper read before the German Leather Trades Association, Prof. Paessler points out that the intrinsic value of tanning materials depends on the amount of *extractable* tannin they contain, and the following table shows the real cost of the chief commercial tanning materials, *i. e.* the price of each per unit of actual tannin :—

	Average cost per 100 kilograms.	Average per percentage of tannin present.	Average cost of tannin per kilogram.
	Shillings.		*Shillings.*
Oak bark	10·5	9·0	1·17
Oak bark extract	25·0	25·0	1·0
Valonia	25·0	27·0	0·93
Quebracho	12·0	19·0	0·63
Divi-divi	24·0	28·0	0·63
Wattle bark	20·0	33·0	0·61
Myrabolans	15·0	30·0	0·50
Mangrove bark	15·0	38·0	0·39

The choice of the material cannot be made solely according to the cost, as many of the tanning materials are used only for special purposes. It is worthy of note, however, that the cheapest materials of general application are mangrove bark and wattle bark, both of which are largely produced in British possessions.

Although, in general, the extraction of a tanning material should be made fairly complete, it is possible to go too far with the treatment, as the whole tannin content is not of uniform value. The less soluble portions are more expensive to extract and they also produce a poorer and darker-coloured leather. Besides this, the precipitation of the insoluble tannin in the cold liquors is a great hindrance to expeditious tanning, as it is well known that the best results are always obtained with clear liquors.

Many tanning liquors on standing deposit insoluble matter, which appears to be formed at the expense of the tannin. This naturally lowers the leather-making capacity of the extract, besides allowing the precipitate to hinder the action of the part remaining in solution. Other materials, however, remain perfectly clear on keeping and are therefore more economical. The following table shows the percentage of insoluble matter deposited from tanning liquors of 2° Bé. after sixty days, in Paessler's experiments :—

Mangrove bark	0·0	Oak bark extract	11·5
Wattle bark	0·0	Galls	16·0
Quebracho wood	3·4	Myrabolans	24·0
Gambier	0·0	Valonia	29·0
Oak bark	7·5	Divi-divi	29·0

In this case also mangrove and wattle barks proved particularly satisfactory.

Although, owing to the general use of mixed tannages, it is difficult to say, definitely, which materials are most readily absorbed by hide and consequently produce the heaviest leather, it appears from experiments conducted by Prof. Paessler that the relative order is as follows:—quebracho, wattle, oak extract, oak bark, mangrove, divi-divi, myrabolans and sumach. From the four points of view here considered wattle bark is therefore the most useful of the commoner tanning materials, and is closely followed by mangrove. The disability attached to the latter of producing a red-coloured leather is also fast disappearing with the application of bleaching processes in leather manufacture.

The Manufacture of Hydraulic Cement from Blast Furnace Slag.—It has been known for a considerable time that a cement can be made by the addition of slaked lime to finely powdered blast furnace slag, and the production of this material has been carried on to some extent in the United States.

A true Portland cement can be made by using slag in place of clay or marl in the ordinary process of cement manufacture. For this purpose the slag is thoroughly granulated by running it into water, and is then dried, and ground. Limestone is added, to the requisite amount, and the mixture is fired to clinker in rotary kilns, using ground dry coal as fuel. The clinker is stored as long as possible before grinding, in order to carbonate any free lime.

A German modification of this cement is known as "Eisen-Portland." This material consists of a Portland cement made from slag and limestone, to which is added not more than 30 per cent. of dried and granulated slag. This cement sets more slowly in air than Portland cement, but is as strong as the latter material. Other cement works in Germany make finely ground slag the basis of their material, and add more or less Portland cement.

In Great Britain only one firm at present is utilising blast-furnace slag for the production of cement. The process used is that of Dr. Colloseus, of Berlin. In this the molten slag from the blast furnace is poured on revolving drums, which rotate at about 650 revolutions per minute. During this operation water containing five per cent. of magnesium sulphate in solution is sprayed on the slag. The resulting granulated clinker, which is quite dry after the operation, is allowed to cool, and ground in tube mills.

The novel part of this process lies in the employment of a salt solution instead of water for granulating. It is claimed that acids liberated from the salt solution under the influence of the high

temperature will react with sulphur present in the slag, and cause its dissipation, as sulphuretted hydrogen or sulphur dioxide.

This method of working appears to possess the disadvantage that the slag is treated as a uniform product. No matter what variations may appear in the composition of the slag, no allowances for these are possible in the course of manufacture. A slag low in lime and high in silica is treated in the same manner as one which approximates closely in composition to a true Portland cement.

The Colloseus process does not appear to have met with general adoption in Germany, as only two works have applied it, while seven firms are manufacturing the Eisen-Portland cement. In the United States two plants are in operation.

Very good mechanical tests have been obtained with Colloseus cement. Dr. Michaelis, in Germany, found that the neat cement, hardened in water, gave after seven days a tensile strength of 536 lb. per sq. inch, and after twenty-eight days 543 lb. A mixture with three parts of sand gave after seven days a tensile strength of 274 lb. per sq. inch; after twenty-eight days, 285 lb.

An article on the Colloseus process, as worked in Great Britain, appears in *The British Clayworker* of October, 1909, while a general review of methods of utilising blast furnace slag occurs in the *Engineering Magazine* of June 1909. *Die Hochofenschlacke in der Zementindustrie*, by Dr. Passow, of the Chemisch-Technische Versuchs-station at Blankenese, also deals with this subject. The latter work includes a bibliography of literature concerning slag cement, and specifications of the latest patents.

Heveas in West Africa.—At the International Congress of Tropical Agriculture and Colonial Development held recently at Brussels (see p. 129), a paper was presented by M. Yves Henry, the Director of Agriculture of the French Colonies, on "L'Hévea à la Côte Occidentale d'Afrique." M. Henry states that *Hevea brasiliensis*, the Para rubber tree, has been tried experimentally at Camayenne in French Guinea, at Dambou in the Ivory Coast, and at Porto Novo in Dahomey, and that in all these cases the trees have given very disappointing results. At Camayenne the trees have proved almost a complete failure, whilst at Dambou and Porto Novo the yield of rubber obtained has been very small. On the other hand M. Henry quotes the results of experimental tappings of specimens of *Hevea Spruceana* growing at Porto Novo which are much more promising, and he draws the conclusion that this species of Hevea is more suitable for cultivation in West Africa than *Hevea brasiliensis*. M. Henry claims that this conclusion as to the value of *Hevea Spruceana* as a source of rubber is confirmed by experiments made in Lagos, and in the Gold Coast.

The botanical identity of the trees in Lagos and the Gold Coast to which reference is made does not appear to be certain, and until further information is available it would be premature to adopt M. Henry's conclusions.

RECENT REPORTS FROM AGRICULTURAL AND TECHNICAL DEPARTMENTS IN THE COLONIES AND INDIA.

In this Section of the Bulletin a Summary is given of the chief contents of general interest of Reports and other publications received at the Imperial Institute, from Agricultural and Technical Departments in the Colonies and India.

ANGLO-EGYPTIAN SUDAN.

THE following notes on the progress of trade and agriculture in the Sudan have been taken from recent monthly reports of the Central Economic Board at Khartoum.

Gum Trade.—The Governor of White Nile Province reports that the 1909 season was a prosperous one commercially for Dueim. Kakamut gum, from *Acacia Suma*, is found in some quantity in the neighbourhood of Gallabat, and an offer to purchase some hundreds of tons is stated to have been made. The gum is said to be superior to Talh gum in colour, cleanliness and strength. Three new villages have been formed on the Setit River, between Gira and Hagar Zuruk, in Kassala Province, with the object of developing the gum forests in that neighbourhood. The Governor of Upper Nile Province states that the people of the Shilluk country began to collect gum in 1909 for the first time, and upwards of 1,000 cantars were brought into Kodok by the tribe and sold for about £E450.

Castor Seed.—Indian and Java castor seed was grown experimentally on the Kassala farm during 1908–09. It was found that the Java variety could be picked at less cost, but was more expensive to thresh than the Indian. Both varieties were easier to gather than Sudan castor seed. If it is found that Indian and Java seed can be grown in the Sudan under favourable conditions—for example, as a rain crop, or near the river or railway—there would appear to be considerable possibilities in this seed as a product for export. Experiments with Indian and Java seed are being made in other localities in the Sudan.

Dura.—There was a very large increase during the year 1909 in the export of dura, which has become an important factor in the food supply of Upper Egypt. The extension of the railway to the dura-producing areas of the Blue Nile will have an important effect, as it will be possible to put the new crop immediately on the Khartoum market, instead of waiting some months for the Blue Nile to rise sufficiently to render transport possible. As a result of this quicker transport it should be possible in course of time to put Sudan dura on Aden and Red Sea markets at the same time as, if not earlier than, Indian dura, namely in February. Cultivators and exporters have been

advised to grade dura, as mixed qualities do not sell so well as clean grades.

Barley.—A sample of barley grown in Dongola Province was sent to the Imperial Institute last year for valuation and report. It was submitted to commercial experts, who reported that it was of promising quality and suitable for malting. Its value in London (August, 1909) was 24*s.* per 400 lb., English barley being then quoted at 24*s.* 5*d.*

Dates.—Some 1,200 Algerian date shoots are being planted experimentally this year in Dongola Province. The kinds obtained are "Deglet-el-Noor" and "Monakhir," both valuable "soft" dates. The cultivation of these dates, if successful, will be of considerable value to the country. Forty date trees obtained from Dongola Province were last year planted out at Singa, in Sennar Province, as an experiment.

Cotton.—The area under cotton in 1908–09 is stated to have been 21,000 feddans compared with 18,006 feddans in 1907–08 and 16,397 feddans in 1906–07.

EAST AFRICA PROTECTORATE.

Agricultural Journal, 1910, **2**. Part 4.—An account is given of a conference held at Nairobi in April 1909, to discuss sleeping sickness and stock diseases prevalent in the country—The study of anthropology—Extracts from a diary written during a journey down the Tana river—Irrigation in British East Africa—Notes on Ceará rubber in German East Africa (gives information regarding the soil and climate of German East Africa and the methods adopted in cultivating the Ceará rubber tree. The trees are planted at the rate of about 435 per acre, and during the first few years the plantations are weeded clean, and later on are weeded about twice a year. As a rule no intermediate catch crops are grown)—Tea cultivation at Limoru (the exports in 1908–09 amounted to 107,199 lb., and in 1909–10 to 157,355 lb.)—School gardens and practical hints for the propagation of plants in connection with them—Tillage.

RHODESIA.

Agricultural Journal, 1909, **7**. No. 2.—The importation of plants (an explanatory article on the regulations in force to prevent the introduction of plant diseases)—The ground-nut or pea-nut (a general article describing varieties, cultivation, harvesting, uses, etc.)—Broom corn—Foul brood in bees—Farms and farming in Rhodesia (describes the climate, soil and crops of the Bulalima—Mangwe district)—The sword bean—Toowomba canary grass—Bobs' wheat and barley wheat (the last three articles are short notes on these subjects from the Botanical Laboratory of the Department). No. 3.—The winter feeding of farm stock (gives short descriptions of the principal winter crops which can be raised in Rhodesia for this purpose)—The potato-tuber moth. No. 4.—Notes on blood-sucking flies—Ensilage—Agri-

cultural and Veterinary Laboratory, Salisbury (an illustrated description of the laboratory, with notes on the work to be undertaken)—Maize blight (a note on *Helminthosporium tinctorium*)—Potato scab—Scale on Citrus trees (rosin wash is recommended as a remedy)—Goromozi District (a description of the farms existing and the crops grown in this area).

TRANSVAAL.

Agricultural Journal, 1910, 8. No. 30.—Notes on stock diseases of German and British East Africa and Uganda, and the resolutions of the International Veterinary Congress at the Hague, 1909—Rural accountancy—Berries and bush fruits—The prevention of malarial fever—Some wild products—Cattle-breeding—A national College of Agriculture for the Transvaal (continued from the previous number)—Wattle-growing for bark (it is pointed out that with the advent of increased railway facilities in the Eastern Transvaal considerable areas of land suitable for wattle-growing will be opened up, and in that connection a general article on the plantation of wattles for bark is published—South African maize for manufacturing purposes (points out that for the manufacture of cornflour, maize rich in starch is required)—Toowomba canary grass—The mealie stalk-borer or mealy grub, *Sesamia fusca* (gives a description of the pest and suggests remedial measures against it)—Fumigation of buildings against insect pests—Some insects new to the Transvaal (describes the castor-oil borer moth and a beetle, *Chrysobothris dorsata*, attacking peach-trees)—Late frosts—The olive (an article describing the cultivation and preparation of olives for the market)—Tobacco growing in the Barberton district—Is Africa getting drier?—The Durham wheats—The Springbok flats as a dry-farming region—Notes on dry-farming—The Lichtenburg Experiments. No. 31.—The Experimental Farm, Potchefstroom (the first of a series of articles describing results of experiments carried out at this farm during the last few years. The present article deals with trials of maize varieties, effect of distance of planting, the use of selected maize seed, the value of maize varieties as fodders, manurial experiments, etc.)—Sugar-cane in Cuba—A problem in soil fertility (points out that sandy soils form a very large proportion of the soils of the Transvaal, and these are usually deficient in organic matter and nitrogen. This deficiency can best be remedied by green manuring)—An experiment in breeding a new variety of maize (describes the production of a new sweet corn, which it is proposed to call "Arcadia sugar-maize")—A note on correlation of characters in maize breeding—Degree of dryness of maize required for safe shipment (from the results of an experimental shipment from Durban to London of eleven bags of maize containing different amounts of moisture, it is concluded that in order that the grain may arrive in good condition it should be shipped containing only 9·5 per cent. of moisture if possible, and in any case not more than 12 per cent.)—Relative maize yields of different districts of the Transvaal

—Corky scab of the potato—A new disease of citrus fruits (gives a description of the black-rot of the lemon, first observed in lemons imported to the Transvaal from Natal)—Leaf blight of the pear and quince—Cotton (the first of a series of lectures on this product given at the Potchefstroom Agricultural College)—Wool-classing for the market—Dry-farming in Russia—Dry-farming in Canada—Rainfall over South Africa.

Mines Department. Annual Report of the Government Mining Engineer for the Year ended 30th June, 1909.—The values of the output of various minerals for the year under review and that for 1907–08 were as follows. The 1907–08 figure is given first in each case.

Gold, £28,508,368, £30,985,966 ; silver, £90,175, £87,457 ; coal, £778,659, £851,150 ; diamonds, £1,879,551, £1,295,296 ; stone, brick, pottery, etc., £153,615, £173,555 ; chemicals, £4,834, £24,300 ; lime, £52,474, £61,955 ; copper, £32,400, £49,027 ; tin, £81,677, £148,336 ; lead, £21,761, £25,432 ; magnesite, £900, £1,487 ; asbestos, £11,502, £7,400 ; zinc, £5,837, £4,083 ; mercury, £5, nil ; graphite, £20, £78 ; flint, £12,350, £23,776 ; mica, nil, £200.

The question of the possibility of establishing an iron and steel industry has been under consideration during the year. It was recommended that an electric plant for working up scrap into high-class steel should be installed to demonstrate the feasibility of the process ; and that the smelting of iron from ores should be encouraged by a bounty system similar to that adopted by Canada. It was expected that the stimulus thus given to the iron industry would be productive of good results in the near future.

A revival of activity has already resulted from the continuation of the Selati Railway to the neighbourhood of the Murchison, and the Pietersburg line northward to Bandolier Kop, and a considerable development is expected as a result of these extensions. The water supply in the Murchison range has been thoroughly investigated, and a scheme formulated for the sinking of bore-holes, at an estimated cost of £3,400, in the districts where antimony ore, mica and corundum occur.

During the year, an Act came into force whereby the fee for the right to prospect was cheapened, and prospectors can now, for a small annual sum, roam freely over Crown lands in their search for minerals with as little hindrance and as few formalities as possible. Under this system a prospector can move his pegs at will, and while being amply protected on the scene of his operations, he is not tied, and can follow the mineral indications and shift operations from place to place. In such extensive districts as the Barberton and Pietersburg fields, this class of permit is specially appreciated.

NATAL.

Agricultural Journal, 1909, **13.** No. 6.—The farmer and scientific research (a review of *Cedara Memoirs,* Vol. I., *see below,* pointing out

the useful part played by experimental stations in modern agriculture)—The living bee (a further instalment of a series of articles dealing with bee-keeping)—Farming implements and machinery (the first part of a general article on agricultural machinery: this section deals with varieties of ploughs suitable for use in Natal)—Kaffir labour—The wattle processionary caterpillar (gives a record of observations on this insect carried out at M'Fongosi, Zululand, from which it appears that the insect is preyed upon by a bug, and for that reason does not, as a rule, do much damage)—Transmission of diseases by insects (directions are given for the recognition and collection of insects, which act as hosts for rinderpest, sleeping sickness, malaria, and other diseases)—Stack silage.—1910, **14**. No. 1.—Natal maize products in England (gives a résumé of information as to the market for maize meal, hominy, etc., in England—The living bee (Part IX. of a series of articles on the management of bees)—Vegetable fibre in wool (gives the findings of a Committee, which met in March 1909, in London, to consider the difficulty, which has arisen in recent years, of vegetable matter in worsted and woollen goods, due usually to the inclusion of loose fibre from the bags used to contain the wool—South African poisonous plants. No. 2.—Natal's trade in 1909 (gives statistics of the principal exports)—Grain-handling appliances—The dried fruits industry (gives information on the picking and preparation for export of dried peaches, apricots, pears, prunes and raisins)—The living bee.—Report on Crown forests for January. No. 3.—The conservation of our natural resources (draws attention to the loss arising from soil erosion in South Africa and the gradual deterioration of the quality of the soil by over-cultivation, and points out that these should be remedied by conservation of water, irrigation, and green manuring)—Export of Natal fruit (a report by the Commercial Agent for Natal in London on the fruit exported from Natal during the last season)—The Methley plum and its export—The living bee—Lucerne tylenchus—Experimental farm reports.

Cedara Memoirs on South African Agriculture, 1909, Vol. I. *Cultivation of Cereals in South Africa.*—This volume consists of a series of reports dealing principally with experiments in the cultivation of maize and other cereals in Natal. In the first report the climate of Natal and the geology of the country, in so far as this affects the soils of the Colony, are discussed. A general discussion of Natal soils is then given, accompanied by analyses of typical soils. The general deficiency in phosphates and lime of South African soils is mentioned, and descriptions and analyses of the phosphate deposits at Weenen are given, and notes are also supplied of occurrences of limestone suitable for agricultural use. The succeeding reports deal with various questions connected with the cultivation of maize. In report No. 4 the growth of maize, rice, wheat, oats and rye under irrigation is discussed, and report No. 5 deals with the "rust" problem. Experiments with millets are described in the next report, and finally the

commercial aspect of trade in cereals is discussed. In appendices a summary of information available regarding the manufacture of paper from maize stalks is published, and the results of an investigation of the malting qualities of sorghum, maize, and other South African cereals. The volume is illustrated with a series of well-executed plates of agricultural machinery and other subjects dealt with in the text, and an exhaustive index to the contents is supplied. The volume should be of great value to farmers, not only in South Africa, but also in other parts of the world where the cereals dealt with are grown.

CAPE OF GOOD HOPE.

Agricultural Journal, 1910, **36**. No. 1.—Wheat hybridisation (during the last few seasons, experiments on the crossing of wheats with a view to the production of a variety which will be rust-resistant in Cape Colony have been carried out, and it is hoped that next season a certain quantity of wheat resulting from the first three valuable hybrids produced, will be available for trial. The best of the three appears to be "Union," resulting from a cross between "Gluyas" and "Darling" wheats, and this has been divided into three groups by selection according to lateness of ripening. The other hybrids are named "Darlvan," resulting from a cross between "Darling" and "Van Niekerk" wheats, and "Nobbs," a cross between "Gluyas" and "Du Toits" wheats. In these two latter cases, three selections have been made of early and late ripening varieties)—Experiments with ostriches, XIII. (this part discusses the influence of nutrition, season, and quilling on the feather crop)—Notes on some diseases of the ostrich—Agricultural Zoology for South African students—Notes on an intestinal parasite of the ostrich—The fresh fruit export trade (a report by the Trades Commissioner in London on the fresh fruit export trade, season 1909)—Miscible oils for spraying (describes emulsions of mineral oils with rosin soaps, which mix readily and uniformly with water and are therefore suitable for spraying plants as a remedy against scale insects and other pests). No. 2.—Lucerne tylenchus—Locust destruction 1909–10 (gives a report on the work done during the season)—Is South Africa drying up?—Raisins (notes on the varieties of grapes suitable for the manufacture of raisins, with information regarding preparation, methods of packing, etc.)—Agricultural enterprise in the arid sections (describes a farm in the Western Karroo where dry farming is carried on)—Seeds for export (gives a list of the seeds available for distribution by the Agricultural Department for experimental purposes by farmers during the season 1910. Directions for sowing the various seeds and for the cultivation of the crops are given)—Destruction of prickly pear (a note on the results of trials with a new prickly pear exterminator)—The rate of distillation of the volatile constituents in the manufacture of pure wine brandy—Cape fruit for

America (gives the results of an investigation by the Trades Commissioner of the market for Cape fruit in the United States of America). No. 3.—Dry land farming (a report on experiments at Knipboschlaagte in the cultivation of wheat under dry conditions)—Agricultural enterprise in the arid sections (describes farming operations in the Britstown district)—Veld deterioration—Agricultural Zoology for South African students—Soil evaporation (a report on experiments carried out at the Robertson station on the conservation of soil moisture by cultivation)—Flax (a general article on the cultivation of flax for fibre)—Seed testing (gives a description of a simple method of testing the germinating power of seeds, with notes on the usual time taken for germination and the percentage of germination, which should be found in good commercial seed)—The destruction of prickly pear (gives directions for the preparation of an exterminator consisting of calcium polysulphides and sodium arsenite, with information as to the method of using it). No. 4.—Giant twig gall of willow, poplar, peach, apple and other trees (a description of the disease is given; as a remedy the "cutting back" of willows and poplars is suggested)—Influence of forests on water supply—Agricultural Zoology for South African students (continued from previous numbers)—Co-operative experiments on maize (gives reports from the various districts of the Colony on trials with the several kinds of maize distributed for experimental cultivation to farmers by the Department of Agriculture. It seems to be well established by these reports that the variety known as "Leaming Early" is suitable for general introduction and cultivation on a larger scale. The best general results were obtained with "Leaming Early," "Pedrick's Perfected Golden Beauty," "Brazilian Flour Corn," and "Manifold").

INDIA.

Agricultural Departments.

Report on the Progress of Agriculture, 1907–09.—In this Report the Inspector-General of Agriculture reviews the work done by the Imperial and Provincial Departments during the period 1907–09. In the first portion the organisation and relationship of the various departments are discussed, and a brief account is given of the work of the Agricultural Research Institute at Pusa. In the later sections, notes are given of the progress made with various agricultural problems under investigation. Cotton continues to receive a great deal of attention, and the principal lines of work are (*a*) selection and distribution of seed, (*b*) introduction of superior indigenous varieties and better cultivation methods, (*c*) hybridisation experiments, and (*d*) trials of exotic cottons. It is noted that tree cottons have generally failed throughout India, and the experiments with these kinds at the Mourbhanj farms have been abandoned.

The Punjab wheats have been classified, and twenty-five types have been isolated and are now under trial at Lyallpur. Similar surveys of wheats are in progress in other provinces.

The area under ground-nut is increasing rapidly, especially in the dry zone of Burma. Tobacco is being grown experimentally in Bengal, Madras and Bombay. Arrangements are in progress for the trial of American tobaccos in Burma and for the experimental production of cigar and pipe tobaccos in Madras. Other crops discussed are jute, flax, indigo and cassava. Trials of the new artificial fertilisers, calcium nitrate and calcium cyanamide, in various parts of India have not given promising results. The former gave a slightly increased yield in the case of wheat and flax, but the increase did not leave any margin of profit. Much work is being done in improving native crops by the distribution of clean and improved seed of various crops, and by the gradual introduction of better forms of agricultural implements. The Report concludes with a complete list of agricultural publications issued in India during the two years under review.

Report on the Introduction of Improvements into Indian Agriculture by the Work of the Agricultural Departments.—This Report records the efforts which have been made by the Agricultural Departments of India to ascertain the needs of the cultivators, and to demonstrate the manner in which they can most effectually be met. An account is given of the improvements which have been introduced. Reference is made to the, following methods of introducing improvements:—(1) the formation and development of agricultural associations or societies for the purpose of arousing interest and bringing the Agricultural Departments into direct communication with the cultivators, (2) local demonstrations, (3) the institution of village agencies for the distribution and repair of agricultural implements, (4) the publication of agricultural journals printed in the vernacular, (5) the issue of leaflets and circulars, (6) the utilisation of the general vernacular press, (7) agricultural shows and exhibitions, (8) the employment of itinerant assistants, (9) the establishment of seed farms and seed depôts, (10) the colonisation of backward districts by expert cultivators, (11) the utilisation of individual expert cultivators for the introduction of improved methods in new districts, (12) training the sons of cultivators, (13) utilisation of the Court of Wards Estates, and (14) co-operation between Officers of the Agricultural Department and District Officers. Many of these methods are adapted to special conditions. The success of a particular method in one district by no means ensures its success in another, since the conditions vary enormously in different parts of India. Emphasis is laid on the necessity of winning the confidence of the cultivators and of promoting a spirit of enquiry among them.

Agricultural Research Institute, Pusa, Bulletin No. 15. *Note on the Extension of Cultivation of Fibre Plants in India.*—The information contained in this publication has been compiled by a special Committee. The fibre crops are arranged in three classes, viz. (1) the ryots' crops, including jute, *Hibiscus cannabinus*, *Crotalaria juncea* and coconut fibre, (2) capitalists' crops, such as rhea, *Agave*, pineapple, *Sansevieria*, and flax,

and (3) fibres which merit experimental trials, such as plantain, *Malachra* and *Sida*. An account is given of the present position of the cultivation of these fibres in the various Provinces of India, and the prospects of extension.

Jute-growing is increasing in Bengal and in Eastern Bengal and Assam, and trials which have been made in other parts of India show that it might be cultivated with success in certain districts of Madras and the Central Provinces. *Hibiscus cannabinus* is cultivated in many parts of India but chiefly in Madras and Bombay. It is capable of growth under conditions in which jute would not succeed without irrigation, and its cultivation might therefore be extended in regions which have too small a rainfall for jute. Sunn hemp, the fibre of *Crotalaria juncea*, which finds a market as a substitute for ordinary hemp (*Cannabis sativa*), is produced in Bombay, Madras, Eastern Bengal and Assam, and to a small extent in the Punjab, the United Provinces and Burma. As *Crotalaria* is a leguminous plant and has the property of enriching the soil in nitrogen, it is sometimes grown as a green manure. It is possible that its cultivation could be extended profitably in Eastern Bengal and Assam, but it is necessary that the plantations should be located on the river banks as in other places the supply of water is insufficient for retting. Coconut fibre is produced chiefly in Madras, but the palm grows in all the coast districts of India, and is abundant in Bombay, Bengal, and Eastern Bengal and Assam. The cultivation of the coconut palm and the extraction of the fibre might well be encouraged in Burma; a coir factory already exists in Rangoon.

Rhea is capable of satisfactory growth in many parts of India, but has not proved to be a profitable crop. The cultivation of *Agave* has been carried on for some years on a plantation in Assam, but the results are not such as to ensure that it would form a remunerative industry. The fibre of *Agave Vera-Cruz* has been extracted on a commercial scale in the Coimbatore District, Madras, from plants growing beside the railways. Several plantations of Sisal agaves have been established by European planters in Madras, but it is not considered likely that this crop will be grown by the ryots. In the Central Provinces, *Agave Cantula* is grown to some extent as a hedge-plant, but comparatively little fibre is extracted, and it is not probable that the cultivation will become popular. *Agave Vera-Cruz* occurs in Burma, but is not systematically cultivated as a fibre crop. The preparation of pine-apple fibre is not likely to become an important industry in any part of India, although it is thought that it might possibly prove remunerative in Southern India. *Sansevieria* has been grown at various times by Assam planters, but the crop has not yielded a profit. Flax is being submitted to extensive trials in Behar (compare this *Bulletin*, 1908, p. 401). It is hoped that it may be possible to grow this fibre with success in several parts of India and, in some places, to obtain both fibre and seed from the same plants.

Plantains are at present grown in India exclusively for fruit. The fibre of these plants is weak, is only of about one-half the value of Manila hemp, and is obtainable in but very small yield. Experiments with *Sida* fibre have given promising results, but the crop cannot be recommended for general cultivation until certain difficulties have been surmounted. *Malachra capitata* has been made the subject of experiments both in Bengal and in Eastern Bengal and Assam, but the results indicate that its cultivation is not likely to be profitable.

In concluding the Report, the Committee recommend the extension of the cultivation of jute, Sunn hemp and *Hibiscus cannabinus*, and express the opinion that the linseed plants at present grown over large areas for seed may also be utilised for fibre. They emphasise the desirability of so arranging the rotation of food and fibre crops that the latter shall not be grown at the expense of the former, and, from this point of view, regard those fibre crops which occupy the land for only a single season as preferable to those grown as perennials.

Agricultural Journal, 1910, **5**. Part 1.—The cattle conference of Lucknow—The introduction of improvements into Indian agriculture—Experiments in the storage of seed potatoes (gives the results of a number of experiments made to discover a method of preventing the attack of seed potatoes by the potato moth. The best results were obtained by dipping the seed potatoes in petroleum emulsion, and then storing them in sand—The efficiency of the Hadi process of sugar manufacture—Agriculture in the Kachin Hill Tracts, Bhamo district (gives an account of the soil and climate, the crops grown, and the rotations practised)—Potatoes in Upper Burma.

Agricultural Ledger, 1908–09, No. 5.—The composition of Indian rice. No. 6.—Indian pens, their history, classifications, materials used, and methods of manufacture.

BENGAL. *Department of Agriculture, Leaflet* No. 6 of 1909.—*Potatoes —Cultivation, Manuring, Varieties, Storing and Seed Supply in Bengal.*— Experiments on potato-growing have been in progress in various parts of Bengal since 1890, and have included work on manuring, varieties, methods of planting, rotation, storing and seed supply. It has been found that potatoes grow very well in rotation with jute or maize, and that both crops can be obtained from the same land in one year. The seed potatoes should be obtained from a more northern or colder climate, and Naini Tal, Patna and Darjeeling varieties are recommended. Information is given as to the best methods of preparing and manuring the land, and planting the seed potatoes.

Quarterly Journal, 1909, **3**. No. 2.—The teaching of agriculture in the elementary schools of France—A note on the past history of the sugar-cane crop in Bengal—Agricultural co-operation—Irrigation in Orissa—Handloom weaving in India—The potato-moth at Patna—Agricultural aphorisms of Bengal. No. 3.—Agricultural exhibitions—A note on the past history of the sugar-cane crop in Bengal—*Sesbania*

aculeata, as a green manuring crop for Chota Nagpur. (This crop has recently been employed in the tea districts as a green manure, and its more extended use is recommended)—Irrigation in Orissa—"Tukra" disease in mulberry (this insect pest, *Dactylopius nipæ*, commonly attacks bush-mulberry, grown in Bengal for rearing silkworms. The effects of the insect are described, and the plucking and burning of affected leaves and shoots is recommended)—A jute-mill on the Hooghly (gives a description of the mill, discusses the labour conditions, and gives information regarding the source of the jute used)—Dyes and dyeing in Bengal—Palas flower (gives a description of the native method of dyeing with the flowers of *Butea frondosa*)—Agricultural aphorisms of Bengal.

EASTERN BENGAL AND ASSAM. *Report on the Operations of the Department of Agriculture*, 1908–09.—Experiments are being carried out on the improvement of jute by selection and hybridisation. Trials have been made with jute in several localities in order to test their suitability for the production of this fibre in commercial quantities. An investigation is in progress as to the cause of the so-called "heart-damage," which sometimes occurs in bales of jute, and the best means for its prevention. The cultivation of flax in Behar is giving very promising results. Attention is also being given to other fibres, including *Sida* sp., *Urena lobata*, and *Asclepias semilunata*. At the Rangpur Farm trials have been made with Darjeeling and Nainital potatoes, several varieties of tobacco, mustard, and ginger, and also with wheat, barley, and oats. Jamaica ginger gave a very satisfactory yield, but the results obtained from the cultivation of exotic varieties of tobacco and mustard were inconclusive. A quantity of "Buri" cotton seed was distributed to cultivators in various districts, but the seed arrived rather late, and the results were disappointing everywhere except at Lumding, where a good crop was obtained. Dharwar American cotton has been grown at Pabna with good results. Efforts are being made to improve the local stock of poultry, and also to encourage sericulture.

Annual Report of the Agricultural Stations for 1908–09.—*Dacca*.—The land on which this farm is situated was acquired in 1906. The work so far carried out has been chiefly of a preparatory nature, including clearing and levelling, road-making, building and the reclamation of tanks. The experiments carried out have been directed to the improvement of the typical high land which forms the greater part of the farm, and the cultivation of winter rice in the ravine lands or "holas."

Burirhat.—This station was started in 1907, and in 1908 the work of the Rangpur farm on tobacco cultivation was transferred to it. A large amount of work has been devoted to clearing and preparing the land. Tobacco, oats, mustard and potatoes have been planted, and a crop of cowpeas has been grown as a green manure.

Rajshahi.—This farm has been in existence since 1904. Experi-

ments have been made with sugar-cane, jute, wheat, potatoes, ground-nuts and *Malachra capitata.*

Jorhat.—This station was established in 1906, principally for sugar-cane investigations. Experiments with several varieties of sugar-cane have shown that the plant-cane is superior to the ratoon-cane. The plant-cane of all the varieties tried gave a higher percentage of cane-sugar and a lower percentage of glucose than the ratoon-cane, although, in many cases, the ratoon crop gave the larger weight of cane per acre. Trials have also been made with winter rice, ground-nuts, potatoes, linseed and various fruit trees.

Shillong.—The Shillong Fruit Garden was established in 1902 in order to test the possibility of introducing various European fruit trees into the hill districts, which possess a climate resembling that of the warmer regions of Europe. The chief obstacle in these districts is the early arrival of the monsoon which renders the atmosphere excessively humid and thus interferes with the ripening of the fruit. Experiments have been made with apples, pears, plums, apricots, Spanish chest-nuts, grape-vines, citrons, strawberries, Khasi oranges, gooseberries raspberries, currants, rhubarb, asparagus and other plants. Consider-able work has been done in propagating fruit trees by grafting and budding, and large numbers of stocks of wild apples, pears, plums Khasi cherries, and grape-vines have been planted for the purpose Considerable success has been attained in rearing the European uni-voltine silkworm, and it has been found that the seed produced in the garden is quite as good as imported seed. A large number of mul-berries have been planted with a view to obtaining cuttings and plants for distribution.

Upper Shillong.—Since 1903 this farm has been worked in conjunc-tion with the Fruit Experiment Station. The main objects of the farm are the introduction of superior varieties of potatoes, the cultivation of fodder crops, the preservation of fodder in silos, and the encouragement of fruit culture. In addition to work on these lines, attention has been given to the breeding of cattle and sheep, with the object of improving the local breeds.

Wahjain.—This is a tropical plantation, which was started in 190 for the purpose of introducing certain tropical products of Ceylon and Madras, such as cocoa, cardamoms, cinnamon, nutmeg, clove, camphor and lemon-grass. This work is being carried out, and experiments have also been made in budding oranges on various citrus stocks.

Reports of the Chaibassa Tasar Silk-rearing Station for 1907–08 *and* 1908–09.—This station was opened in 1906 with the object of ascertain-ing whether the decline of the tasar silk industry of Bengal is due to neglect on the part of the rearers or to deterioration of the stock The various causes contributing to the decline are discussed in the reports. An account is given of the life-history of the tasar moth (*Antheræa mylitta*), the climate of the Singbhum District, the pests by

which the caterpillar is liable to be attacked, and the conditions of the local tasar silk trade. In 1907–08, in addition to silk-rearing experiments, trials were made with various crops. Good results were obtained with jute, "Buri" cotton, and Naini Tal and Patna potatoes. In 1908–09 the tasar work was continued, and attention was given to the cultivation of "asan" (*Terminalia tomentosa*) and "arjun" (*T. Arjuna*) trees, on the leaves of which the silkworm feeds. Manurial and selection experiments were also carried out with the "Buri" cotton plant.

MADRAS. *Report on the Operations of the Department of Agriculture*, 1908–09.—The new Mauritius sugar-canes which have been introduced are rapidly replacing the inferior local varieties in the Godavari and South Arcot districts. The area under the new canes in the latter district has increased during the year from 60 to 247 acres, whilst there are now only 130 acres under the old kinds. Mauritius canes are also growing satisfactorily in Ganjam, Tinnevelly and Malabar. Ground-nut cultivation has become well established in the Palghat region of Malabar, and will extend rapidly. The attempt to introduce this industry into South Canara gives promise of success. In order to improve the quality of the cotton grown in the Ceded Districts, it has been decided to distribute seed of the pure white-seeded "Northerns" variety, and 45 acres are being devoted to this cotton in order to obtain the necessary seed. In Tinnevelly, large quantities of pure "Karunganni" seed of an improved strain were supplied to growers. Cotton seed was sown by means of the drill on an area of 1,000 acres in Tinnevelly; demonstrations of the advantages of this practice and the manner of using the drill are being given to the cultivators. The single planting of rice is being practised to an increasing extent both in Tanjore and Tinnevelly. Attempts to grow Bengal jute in the Godavari Delta and in Tanjore and Malabar have failed. The agave plantation at Hindupur was extended, and trial cuttings indicated that an annual yield can be obtained of 430 lb. of dry fibre per acre. The reports of the various Agricultural Stations are appended to this Report and are also published separately (see below).

Bellary Agricultural Station, 1908–09.—An account is given of experiments with cotton and sorghum. Several Indian varieties of cotton have been tested, and although no variety has been found which will grow better than the local "Jowari" in a bad season, it is considered not unlikely that in a good year one of the introduced varieties might prove superior both in quality and quantity. Selections are being made with the object of increasing the proportion of fibre to seed, and a general improvement in this respect is already noticeable. The sorghum was sown very late owing to the lateness of the monsoon, and consequently only small yields were produced. "Kagi jola" (crow sorghum) gave the best results of all the varieties tried. A series of manurial experiments has been carried out, and the results are recorded. Efforts are being made to reclaim a saline area.

Hagari Agricultural Station, 1908–09.—Investigations are being continued at this station on the behaviour of black cotton soil under irrigation, and its suitability for rice cultivation or for cotton growing with occasional irrigation. A study has been made of the manurial value of the silt deposited from water pumped from the Hagari River. This silt is of two kinds, black and red. Analyses have shown that the silts can exercise but very little manurial action, especially in the case of the black kind. The black silt would also have little effect on the physical character of the soil, whilst the red silt would tend to decrease the proportion of clay. Experiments have also been made with *Setaria italica*, sorghum, ground-nuts and various grasses.

Samalkota Agricultural Station, 1908–09.—The study of the red rot fungus (*Colletotrichum falcatum*) which has attacked the sugar-cane of the district has been continued, and it has been found that the disease can be avoided by lengthening the rotation and not growing the sugar-cane more than once in six or seven years, attention also being given to the drainage and to the selection of seed. Several new varieties of cane have been grown. Analyses have been made of seedling and other canes as well as of jaggeries made from them. Manurial and rotation experiments have also been conducted. Some varieties of rice have been studied, and spacing and transplanting experiments have been carried out. Attempts to cultivate Bengal jute have not proved encouraging, but Bimlipatam jute has given better results. Experiments have also been made with turmeric, guinea grass, maize and cowpeas.

Koilpatti Agricultural Station, 1908–9.—This Station consists partly of black cotton soil and partly of a red, coarse, gritty loam. On the black soil experiments have been made on cotton growing as well as on manuring and soil improvement. A study has been made of the two local varieties of cotton, viz. "Uppam" (*Gossypium herbaceum*) and "Karunganni" (*G. obtusifolium*). The latter variety is supposed to be the original Tinnevelly cotton of commerce, and is much superior to the former in length, strength and fineness, but gives a smaller yield. Selection and hybridisation experiments are in progress. Other varieties of cotton have been tested. The work on the black soil has also included the cultivation of new varieties of cereals and a study of the different varieties of Irungu "cholam" (*Andropogon Sorghum*, var. *Irungu*). On the red soil, onions, cowpeas, maize, millet and other cereals have been grown. A comparison has been instituted between different methods of conserving cattle manure, and trials have been made of oil-cakes as manures for garden crops.

Palur Agricultural Station, 1908–09.—An account is given of the cultivation of several varieties of ground-nuts, rice and sugar-cane. In the dry area, the ground-nuts were sown among cereals, and it has been found that the cereal affects the quality of the ground-nut in increasing the percentage of oil. On the wet area, trials have been made with several varieties of rice, and a study of methods of planting and spacing

and some manurial experiments have been carried out. Analyses are given of the varieties of sugar-cane grown, and the effect of different manurial treatment on their composition is recorded.

Taliparamba Agricultural Station, 1908–09.—The investigations in progress at this Station on pepper cultivation are being continued. Work is also being carried out on the methods of cultivating rice and effecting its improvement by seed selection. Two varieties of sugar-cane have been introduced, and analyses of the products are recorded. Ground-nuts have been grown on a dry area as a rain-crop, and have aroused considerable interest, as this crop is quite new to the district.

Nandyal Agricultural Station, 1908–09.—At this Station attention has been particularly directed to cotton and sorghum. The local cotton is a mixture of several types, and an endeavour has been made to separate these, grow the pure forms, and ascertain the value of each. Considerable progress has been made with this work. A good crop of tobacco has been grown by a farmer in Midathur from seed obtained from Dindigul. The number and size of the leaves are in marked contrast with those of the local tobacco plants.

BOMBAY. *Annual Report of the Department of Agriculture*, 1908–09.—The work done at the experiment farms has included trials of indigenous and exotic varieties of cotton, wheat, sorghum, "tur" (*Cajanus indicus*), ground-nuts, castor seed, tobacco and other crops. Attempts have been made to improve the quality and yield of the crops by means of selection, and numerous cultural and manurial experiments have been carried out. The work on cotton hybrids has been continued at the Surat Farm and has given encouraging results, several of the hybrids having yielded a product of considerably higher value than that of the local variety. Broach cotton has been cultivated successfully in the Dharwar District on a commercial scale. Egyptian cotton was grown in Sind on an area of 4,000 acres, but owing to lack of water the seed was sown very late. The plants suffered severely from exceptionally heavy rains, and the crop was unsatisfactory both in quality and quantity. Exotic varieties of ground-nuts have been greatly appreciated, and are being largely grown in several districts. Trials are in progress with a view to determining the advantages of deep ploughing for varying conditions of ordinary dry cultivation.

Bulletin No. 34, 1909. *Night-Soil—A Valuable Manure.*—A description is given of the various systems practised in the Bombay Presidency for the disposal of night-soil, and experiments are recorded which demonstrate the value of this material as a manure. In the case of municipalities which have to dispose of large quantities of town-sweepings as well as night-soil, the manufacture of "poudrette" is considered to be best effected by mixing the night-soil and sweepings, and covering them with a layer of dry earth. Analyses have been made which show that poudrette obtained by mixing night-soil with dry pulverised earth is richer than that in which town-sweepings are used.

It is not always possible, however, to secure sufficient quantities of powdered earth at a sufficiently low cost.

UNITED PROVINCES. *Report on the Administration of the Department of Agriculture for* 1908–09.—Road-side planting has been continued, and during the year 94 miles of provincial roads and 208 miles of local roads have been planted. A striking demand has arisen among cultivators for labour-saving machinery, and, in order to meet this, it will shortly be necessary to establish a large factory for the manufacture of implements. The seed depôts have been exceedingly active, and very large quantities of seed have been distributed. Various experiments are in progress at the Aligarh Agricultural Station with cotton, maize, ground-nuts, wheat and sorghum, and trials are also being made with sugar-cane. At the Patabgarh Agricultural Station, experiments are being carried out on sugar-cane cultivation and sugar manufacture; trials are also being made with rice, maize, hemp and jute.

Report on the Cawnpore Agricultural Station, 1908–09.—The work carried out at this station included manurial experiments with maize, wheat, cotton, sugar-cane, the opium poppy and potatoes, efforts to improve the opium poppy, American cotton, and wheat by selection, and various rotation experiments. Attempts are being made to grow *Cassia auriculata* and *Prosopis juliflora* on waste land. *Melilotus officinalis* has also been tried, but without success. Trials have been made of various agricultural implements.

Botanical Departments.

Report of the Government Botanical Gardens, Saharanpur, 1908–09. —An account of the state of the gardens, the character of the past season, and a record of work on the cultivation and acclimatisation of various plants. Experiments have been made with numerous fruit trees and vegetables, including pears, plums, vines, blackberries, Cape gooseberries, persimmons, apples, peas, Swiss chards and leeks. Several requests were received for Sisal plants.

Forest Departments.

Review of Forest Administration in British India, 1907–08.—A report on the constitution, administration and management of the State forests, including particulars of the output and export of forest produce, and details of revenue and expenditure. At the close of the year under report, the area of the State forests under the control of the Forest Department was 237,809 square miles, or 24·2 per cent. of the total area of British India. In addition to this, there were 1,637 square miles of reserved and 10,341 square miles of protected forest under the control of other departments. The total output of timber during the year amounted to 65⅓ million cubic feet, and that of fuel to 169⅜ million cubic feet. Bamboos were collected to the number of 193½ millions, and the minor forest produce, including grass and grazing, was

of the value of £476,000. The total exports of forest produce attained the value of £3,760,000, and included 149 tons of rubber, 18,138 tons of lac, 74,665 tons of myrabolans, and 39,539 cubic tons of teak. A summary, compiled from the Provincial Reports, is given of the more important sylvicultural work carried out during the period under review.

Forest Memoirs. Forest Zoology Series, 1909, 1. Part 2.—On some undescribed Scolytidæ of economic importance from the Indian region, II.

Forest Pamphlet, No. 12. *Forest Economy Series*, No. 5. *Petwun or Trincomali Wood* (*Berria Ammonilla*, Roxb.).—The "Petwun" or "Trincomali" tree (*Berria Ammonilla*), a member of the *Tiliaceæ*, occurs throughout Burma, and is also found in Southern India and Ceylon. In Burma it is associated with teak in upper mixed deciduous forests of the drier type. The tree and the character and properties of its wood are described. The timber is durable, and is used in Burma for building houses and for the manufacture of oars, ploughs, carts, gun-stocks and other articles. Owing to its toughness, elasticity and straight grain, "Petwun" wood is recommended for carriage-shafts and similar purposes. A specimen of the timber from Ceylon has been received at the Imperial Institute (vide *Technical Reports of the Imperial Institute* (1903), pp. 256, 259–262). It is not considered likely that the output of the timber in Burma would exceed 1,500 tons per annum. The duty rates and approximate prices in various localities are tabulated. The bast fibre of the tree is sometimes used in Burma for cordage, but is not of very good quality. No. 13. *Forest Economy Series*, No. 6. *Burmese "In" Wood* (*Dipterocarpus tuberculatus*, Roxb.).—The "In" tree is widely distributed in Burma, and also occurs in the forests of Chittagong. A map is supplied illustrating the distribution of the tree as ascertained in 1908. It grows in a special type of forest, which normally contains about seventeen "In" trees, not less than 3 feet in girth, per acre. Descriptions of the tree and its timber are given. The wood is of about the same strength as teak, but is not very durable. The royalty-rates, the approximate prices of the timber, and the cost of delivery in various localities are tabulated. It is probable that at least 75,000 tons of "In" timber have been collected annually in Burma for trade purposes during the last five years, and that the quantity available for export in the future will exceed 50,000 tons per annum. The wood is used for building and for the construction of boats and rough articles of furniture and joinery. It is suggested that if the wood is treated with an antiseptic it may be found suitable for railway sleepers and paving blocks. The tree yields a clear resin, employed for caulking boats, and a dark, thick oleo-resin, used for torches. The leaves are used for thatching and packing, and the seeds are employed as food. In order to encourage an industry in "In" wood, the Government of Burma have offered special concessions for

the extraction of the timber for export, but no extensive export trade has hitherto resulted. No. 14. *Forest Economy Series*, No. 7. *Burma Padauk* (*Pterocarpus macrocarpus*, Kurz).—The "Padauk" tree of Burma has been identified by Prain as *Pterocarpus macrocarpus*, Kurz. It occurs in the forests of Upper Burma, Tenasserim, and in the Prome and Thayetmoyo Districts of Pegu. A description of the tree is given, together with an account of its distribution, the climate, geology and soil of the localities in which it grows, and the type of forest it inhabits. As a rule, the tree forms only a very small proportion of the growing stock of the mixed forests in which it is found; estimates are given of the number of trees per 100 acres in various localities. The system of felling and extraction and the properties of the timber are described. The wood is extremely durable, and is of value for the manufacture of cart-wheels, poles of various kinds, frames of transport carts, wheel-barrows and furniture. Trials are being made in Rangoon to determine its suitability for street-paving. The demand for the timber, the market prices in various localities, and the annual output are recorded, and estimates are made of the approximate quantities which will probably be available for export in future years. When good forest roads have been constructed the possibility of a large export trade will be greatly increased.

Forest Leaflet, No. 4. *Forest Zoology Series. The Larger Deodar Bark Borer* (*Scolytus major*, Steb.).—An account is given of the life-history of this beetle, and suggestions are made as to the best means of checking its ravages. The insect is one of the worst enemies of the deodar, and attacks trees of all ages and sizes. The female beetle bores through the bark of the tree into the bast and sapwood, where she deposits her eggs. The larvæ infest the bast layer, and, when present in sufficient numbers, the beetles and larvæ together gradually remove the whole of the bast tissue, with the result that the tree dies. Two insects are described which prey on the bark borer, one a Clerid (*Thanasimus himalayensis*, Steb.), and the other a Histerid (*Niponius canalicollis*, Lewis). No. 5. *Forest Zoology Series. The Blue Pine "Polygraphus" Bark Borer* (*Polygraphus major*, Steb.).—The life-history of this insect somewhat resembles that of the deodar bark borer. The male beetle bores through the bark of the tree and eats out a pairing-chamber. Three female insects successively enter the pairing-chamber, and afterwards penetrate the bast layer in different directions and lay their eggs. The larvæ and beetles together, when sufficiently numerous, remove the whole of the bast tissue, and the tree dies. The beetle is preyed on by the same two insects which attack the deodar bark borer. Remedial measures are suggested.

N.-W. FRONTIER PROVINCE. *Progress Report on Forest Administration*, 1908–09.—On June 30, 1909, the area of reserved forests amounted to 250 square miles, and that of protected forests to 121 square miles. The output of timber during the year was 414,816 cubic feet, and that

of fuel 395,489 cubic feet. Minor forest produce included 2,320 lb. of *Podophyllum Emodi* rhizomes, which realised a price of about 22*s.* 6*d.* per cwt. Work is being conducted on the cultivation of this plant, but the nurseries are not in a very promising condition. Experiments have been made with *Robinia* sp. and with *Eucalyptus globulus*, but the latter trees were killed by the frost.

PUNJAB. *Progress Report on Forest Administration*, 1908–09.—On June 30, 1909, the total area under the management of the Forest Department amounted to 9,014·05 square miles. The output of timber during the year amounted to 6,163,217 cubic feet, and that of fuel to 23,897,835 cubic feet. The blue pine woods of the Simla Hills are seriously infested with a fungus, *Trametes pini*, which reduces the wood to powder, and thus renders it useless either for timber or fuel. In some of the forests the pest has attacked almost every part, and as the only method of arresting its spread is to cut down and burn the infested trees, it appears that large areas of forest are doomed to disappear. Experiments are being made in the Simla Division with Tasmanian species of eucalyptus and with various fruit trees. An investigation is in progress to ascertain the length of time required to kill pine trees by tapping them for oleo-resin. About 3,520 acres in Kangra have been worked for bamboos, and this industry is regarded as capable of considerable extension. The quantity of resin collected was insignificant; but it is anticipated that the out-turn of this product will increase largely in the future.

BALUCHISTAN. *Progress Report of Forest Administration*, 1908–09.—The area of the reserved forests amounts to 282 square miles. During the year 20,302 cubic feet of timber and 402,089 cubic feet of fuel were collected. Numerous experiments were made with the object of introducing exotic forest trees. The Persian pine, pistachio and walnut trees gave satisfactory results. An attempt was made to acclimatise Italian olives for the purpose of grafting them on the local trees, but at the close of the year the results were not conclusive. Various cultural operations were carried out with a view to the improvement of the growing stock and the establishment of plantations of apples, plums, pears, raspberries, roses and other plants.

Geological Survey.

Memoirs. The Manganese Ore Deposits of India, 1909, **37**. (in four parts). The first three parts have been reviewed already in this *Bulletin* (1909, **7**. 425). The fourth part contains a description of the different deposits arranged alphabetically according to the administrative divisions of India in which they occur. Details are given of the geology of each locality, the mode of occurrence and extent of the ore in sight, its mineral and chemical composition and the facilities for mining and transport. This information is illustrated by numerous photographs, maps and sections.

Miscellaneous.

Commercial Intelligence Department. Note on the Production and Consumption of Coal in India up to the year 1908.—This gives (1) the output of each of the administrative divisions of India for twenty years ending 1908; (2) that of individual mines for ten years; (3) the imports and exports from and to different countries, and (4) the consumption of wood and coal on Indian railways for twenty years, and other valuable statistics. The total production has increased since 1888 from 1,708,903 to 12,769,635 tons; the imports have diminished from 601,670 to 455,806 tons, and the exports have increased from 39,972 to 571,582 tons, mainly to Ceylon. They were in 1906–07, 935,350 tons, the decrease since that year being due to the competition of Japan, which has been especially severe in the Straits Settlements.

Indian Trade Journal, 1910, **16**. No. 198.—Tanning material industry for India (suggests that there is an opening for the establishment of a tanning extract industry in India on a large scale, and gives a brief description of the process used in making extracts). No. 199.—The cultivation of Soy beans (a general article on this subject, referring especially to their value as a leguminous crop in increasing the nitrogen content of soil). No. 200.—Manufacture of tanning extracts. No. 201. —Cultivation of Soy beans (a continuation of the article published in No. 199). 1910, **17**. No. 212. Deterioration of cut canes (a note on experiments made recently in Java, showing the production of reducing sugars at the expense of sucrose, when sugar-cane is stored after being cut).—Cotton seed oil (it is stated that the acrid taste of Indian cotton-seed oil can be removed by treatment with alkali).

Papermaking in the Bombay Presidency. A Monograph.—An account is given of the history and present position of the papermaking industry in the Bombay Presidency, together with a description of the methods practised and the materials used. The manufacture of paper by hand was at one time carried on in several towns, but, on the introduction of modern machinery, the industry declined and now survives only in Ahmedabad, Bagalkot, Erandol and Junnar. In Ahmedabad and Bagalkot old gunny bags and sacking are used, whilst in Erandol and Junnar waste paper is the principal material employed. Three paper mills have been erected in the Presidency, but only one of these is now in active operation. This mill produces about 1000 tons of paper per annum, of which 800 tons are supplied to the Government. The chief raw materials are rags and sulphite wood-pulp, supplemented with "sabai" grass (*Ischæmum angustifolium*), mechanical wood pulp and old gunny bags. The report is illustrated.

CEYLON.

Circulars and Agricultural Journal of the Royal Botanic Gardens, 1910, **4**. No. 23.—Die-back of *Hevea braziliensis*. This disease is due to a fungus, *Gæosporium alborubrum*: its symptoms are described, and

in slightly affected plants it is recommended that the diseased portion should be cut off and burnt. This particular fungus only attacks green soft tissue, and the "die-back" in thick woody stems is due to a secondary fungus, *Botryodiplodia elasticæ*. In this case also the cutting or scraping away of the diseased part is recommended, and the tarring of cut surfaces to prevent the entrance of other fungi. No. 24.—Root disease of the cocoanut palm. During the recent investigation of the coconut stem disease in Ceylon (see this *Bulletin*, p. 78) the existence of a root disease was discovered in several widely separated localities. It is probable that this disease is due to the fungus *Fomes lucidus*. A full account of the symptoms is given, and it is recommended that dead or badly diseased trees should be felled, and the affected part, usually the butt of the stem, dug out and burnt, and to prevent spread of the disease from the roots left in the soil a trench two feet deep should be dug round them. No. 25 gives a list of the contents of the first four volumes of this publication.

Tropical Agriculturist, 1910, **34**. No. 1.—Bagasse for paper—Miscellanea, chiefly pathological (deals principally with the discoloration of rubber caused by fungoid growths)—Bee-keeping in Ceylon—Literature of economic botany and agriculture (this section includes entries on fibres, fodders, fruits, Furcrœa, gambier, Garcinia, gingeli, ginger, ginseng, and Glycine)—Minutes of a meeting of the Committee of Agricultural Experiments (gives details of the experimental work done on the plots of tea, cocoa, coconuts, rubber trees, and other plants)—Ceylon Agricultural Society: Progress Report 47—Proposed experimental tobacco cultivation (the Sub-committee recommends that a sum of 27,500 rupees be expended on an experiment on tobacco growing and curing for one year at Maha-iluppalama)—Paper industry in Japan (gives particulars of the materials and processes used).—Artificial cultivation of sponges. No. 2.—Literature of economic botany and agriculture (this section contains entries relating to green-manuring, ground-nuts, guava, Guizotia, gum, guttapercha, hemp, indigo, jute, etc.). No. 3.—Miscellanea, chiefly pathological—Literature of economic botany and agriculture (this section deals with kapok, kola, lac, lantana, lemon-grass oil, Lophira)—Agricultural conditions in Java (reprinted from the Philippine *Agricultural Review*; deals with the cultivation of coffee, cocoa, cotton, cassava, sugar, tobacco and cinchona). No. 4.—Entomological notes (deals with the green bug and the Pulvinaria bug affecting tea, a mealie bug found on *Tephrosia candida*, now being grown in Ceylon as a green manure, and the "paddy fly")—The "wilt disease" of pepper (the symptoms are described, and spraying with Bordeaux mixture is recommended as a remedy)—Canker of cacao—The orange and how to grow it—Improvement of crops by seed selection (deals more especially with seed selection for cotton)—Literature of economic botany and agriculture (this section deals with maize, mango, mangroves, Manilla hemp, maté.

medicago, Melaleuca, Mimusops, Moringa, mulberry, myrabolans, nutmegs, oils)—Peradeniya Experimental Station (a progress report on the various crops under experiment is published).

Administration Reports, 1908.—The Acting Government Entomologist gives a *résumé* of information regarding insect pests affecting tea and other economic plants during the year. It has been decided to try the importation of the insectivorous insect *Clerus formicarius* as a means of eradicating the "shot-hole borer" (*Xyleborus fornicatus*). The Universal Ant Exterminator has been found very useful as a means of destroying termites. The Government Mycologist reports that much time was given to the coconut stem bleeding disease (this *Bulletin*, p. 78) in arranging for inspection of affected areas and in educational work on the subject. A number of new diseases of economic plants were observed during the year, including a root disease of cocoa, "witches broom" on cinnamon, "smut" disease of citronella, etc.

STRAITS SETTLEMENTS AND FEDERATED MALAY STATES.

Agricultural Bulletin, 1910, **9**. No. 1.—A peat-soil note (gives partial analyses of two peaty soils from Pontianac, in which rubber-trees have been planted. The soils contained 56·9 and 76·6 per cent. of moisture and only 0·94 and 0·93 per cent. of ash. At 2½ years of age the trees were 5·59 inches in circumference at three feet from the ground, and, though undersized, appeared to be healthy)—Pricking rubber trees for latex, No. 2.—On the effect of arsenical and sulphur fumes on vegetation with particular reference to the Para rubber tree, *Hevea brasiliensis*, and Rambong, *Ficus elastica* (the results prove conclusively that the fumes are harmful to both trees, and that probably the sulphur dioxide is the more harmful)—Analytical notes on rubber plants in the Botanical Gardens, Singapore (gives analyses of latices from *Hevea brasiliensis*, *Willughbeia firma*, *Chilocarpus enervis*, *Landolphia Heudelotii*, *Tabernæmontana dichotoma*, *Leuconotis eugeniifolius*, *Artocarpus integrifolia*, and *Alstonia angustiloba*. A specimen of "jellotong," coagulated by "purub" was also examined as well as rubber from *Manihot Glaziovii* and *Choneomorpha macrophylla*)—*Corticium javanicum* in Borneo—Strange growth of a Para rubber tree cutting (records the sprouting of a fence post made from the stem of a Para rubber tree). No. 3.—Tillage of soil (points out that though proper tillage of the soil is desirable, care should be taken that it does not lead to excessive denudation and consequent loss of soil—Lallang grass as a paper-making material (a report on paper-making trials with this grass, from which it appears that the grass is of doubtful commercial value, when compared with other materials used for this purpose, but that it might be used in association with pulp derived from other sources)—"Megass" in papermaking (a report on paper made from this material in Trinidad)—Para rubber from old trees (a report on "smoked" rubber prepared from old trees

in the Botanic Gardens, from which it appears that this material was described by brokers as one of the best samples yet received from the East, and that it realised 9*s.* per lb. when sold, which was the highest price obtained on the day of sale)—The abolition of the Botanic Gardens at Penang (the site of these gardens is to be used as a reservoir, and in view of their disappearance a short history of the Gardens is published). No. 4.—Notes on the Angsana tree disease in Penang (this disease has been identified as *Polystictus occidentalis.* The only method of combating it so far found is to cut out the affected trees).

Bulletins of the Department of Agriculture, Federated Malay States. No. 7.—*Coffea robusta* (gives a short account of the history, method of cultivation and preparation of this Congo coffee. It is thought that *Coffea robusta* may be useful as a catch-crop in Para rubber and coconut plantations).

SOUTH AUSTRALIA.

Journal of the Department of Agriculture, 1909, **13**. No. 5.—Milling qualities of South Australian wheats (gives details of the methods of milling used, and the tests applied to the flour in the case of sixteen varieties of wheat grown in South Australia)—The wheat crop: official forecast (the average yield per acre is placed at 11⅓ bushels)—Farm experiments in the north—Annual Report of the Director of Agriculture—Advisory Board of Agriculture—Proceedings at a monthly meeting held on November 10, 1909—The Parafield Experimental Farm—The Phylloxera Board (a report by the Chief Inspector of Vineyards). 1910, **13**. No. 6.—Milling qualities of South Australian wheats (continued from the previous number)—"Bunt" tests, 1909 (gives the results of experiments conducted at the Parafield Experimental Farm with the object of testing the utility of fungicides used for pickling wheat for the prevention of bunt. Formalin solution appears to give good results, but was inferior to a preparation called "fungusine," which appears to be not only efficient as a fungicide, but has also very little effect on the germinating power of the seed)—Annual Report of the Woods and Forest Department. No. 7.—Lucerne harvesting—Forage poisoning (reports on outbreaks of forest poisoning at Mallala, Balaklava and Warnertown). No. 8.—Agricultural experimental work, 1909-10 (gives a *résumé* of the results of dry-farming experiments carried out at Hammond)—Roseworthy Agricultural College: Harvest Report for 1909—Proceedings of the Conference of Agricultural Bureaux, held at Georgetown in February 1910—Notes on lucerne grazing. No. 9.—Some good heads of "Federation" wheat—Roseworthy Agricultural College: Harvest Report for 1909—Improved French wheats (gives the results of trials of four French varieties of wheat imported into South Australia in 1909. The results were disappointing on the whole, but a further trial of the wheats is being made this season)—Trial of Stone-gathering machines — Experimental farm notes—Prickly pear as a

fodder for stock—Agricultural experimental work 1909–10 (the report deals mainly with trials of varieties of wheat, the relative values of incomplete and complete manures, the comparison of varieties of wheat for hay production, and manure tests on grass land).

QUEENSLAND.

Department of Agriculture and Stock. Annual Report for the year 1908–09.—It is stated that though the number of stock last year, viz. 4,321,600, is about three-quarters of a million less than in 1898, the number of individual owners has increased by 5,336, a fact attributable in a great degree to the increase in the number of grazing farms, to the fencing in of areas which before were open country, and to the improvement of the carrying capacity of the State. In spite of a very dry season the wheat harvest compared very favourably with those of preceding years, both as regards total and average yield. The latter amounted to 14·87 bushels per acre. The total output of sugar-cane for manufacture in 1908 was 1,433,315 tons, as against 1,665,028 tons in 1907. Cotton-growing is regarded as a promising industry, and it is pointed out that this is gradually extending, notwithstanding the fact that cotton cultivation has been established twice already on a fair scale in the State and on each occasion allowed to lapse.

Agricultural Journal, 1910, **24**. Part 1.—Wheat rust (continued from the previous number)—Nitrogen as a fertiliser—Fruit and vegetable growing in the Bowen district—Contribution to the flora of British New Guinea—The banana industry. Part 2.—The pickling of green and ripe olives (gives descriptions of the methods used)—Narcissus cultivation (gives a description of the method of cultivation for the production of flowers and bulbs for sale)—Silkworm culture—The cultivation of cacao—Report on experiments with the wild passion flower vine, in connection with the death of cattle in the Beau-desert district (the result of a series of experiments leaves no doubt that the passion-flower vine is responsible for the illness and death of a number of cattle in this district. The poison appears to be of a cumulative nature, and a considerable quantity of the vine must be eaten before toxic effects are made manifest. It is recommended that the vine should be cleared from grazing land as far as possible, and remedial treatment for affected animals is suggested). Part 3.—Notes on artesian and other water supplies. Conservation of fodder, its difficulties and how to overcome them—Report on experiments with winter cereals carried out at the State Farm, Bungeworgorai, Roma, during 1909—The Angora goat, its uses and value—Fruit-growing in the Burrum River district—Fruit-growing in the Gympie district—Potatoes, their inspection and treatment. Part 4.—Asparagus—A new substitute for cotton (states that a process for rendering kapok suitable for spinning has been devised recently in Germany)—Prospects of rubber-growing in Queensland (gives estimates of the cost of planting and the probable

returns of Para rubber plantations in Queensland)—Vanilla culture in tropical Queensland (a description of the cultivation and method of preparing this spice for the market).

Government Mining Journal, 1909, *December*.—Wolfram (tungstate of iron and manganese) at Sunnymount—Coal output of Victoria and New Zealand—State coal mines in New Zealand—State smelting works and State assistance in the sale and disposal of ores—Rock temperature at the Witwatersrand—Cyaniding without crushing—Coal near Hughenden.

Papua.

Handbook of the Territory of Papua. Second Edition, 1909.—Contains the usual general information regarding the Colony, notes on the fauna and flora, and a series of notes on agriculture. In a special section entitled "Hints to Planters," information is afforded as to the best method of clearing jungle, and a list of approved plants likely to do well in the island is printed. The Handbook also contains a series of short articles on the cultivation of Para rubber, with notes on the cost of clearing and planting estates with this product, and similar information is given regarding coconuts, cocoa, Sisal hemp, and tobacco. There is also a short description of the geology of Papua with notes on the economic minerals so far discovered, which include gold, copper, silver, tin, lead, zinc, cinnabar, iron, osmiridium, gypsum, manganese, sulphur, graphite, and the gem-stones, topaz and beryl.

VICTORIA.

Journal of the Department of Agriculture, 1910, **8**. Part 2.—The wine industry in Southern France—The Logan berry—Production and marketing of beeswax—The potato eelworm—A new pasture plant (this describes "Birdsfoot trigonel," *Trigonella ornithopodioides*, Linn., which has recently become established in Victoria)—Tests with cultures of root-tubercle bacteria (the results of a number of trials indicate that the use of cultures is the most expensive and least certain method of infecting a soil with root-tubercle bacteria). Part 3.—Results of continuous wheat experiments (the results of trials of several varieties of wheat on the same land for a number of years are given, and show that, provided proper tilth is maintained and good seed used wheat can be grown for several years in succession without fouling the land)—Advantages of subdivision of estates—Bee mortality—Vinegar from apples (describes the process of preparation)—The "onion eel-worm" (gives results of experiments made with a view to discovering a means of eradicating the pest. It is shown that the worms can be destroyed by the application of various chemicals to the soil, but, so far, no method of destroying the eggs has been discovered)—An abnormal six-rowed barley—Irrigation of lucerne—Insectivorous birds of Victoria (deals

with the bronze cuckoo)—Prickly pear (a discussion of the fodder value of these plants, compare this *Bulletin*, p. 43). Part 4.—The laws relating to the marketing and export of fruit, plants, etc.—Bitter pit of the apple—Erinose of the vine—Potatoes and tomatoes on the same plant—The wine industry in Southern France.

NEW SOUTH WALES.

Department of Agriculture. Report for the year 1908–09.—The report contains detailed information respecting the experimental work of the Department. The dairy branch reports that 15,034,724 lb. of butter were exported oversea, while the interstate exports reached a total of 6,994,772 lb. The export to all quarters for condensed and concentrated milk amounted to 122,495 lb., showing that the condensed milk trade is likely to develop into an important section of the dairying industry. The report of the Fruit Expert shows that this industry is in a satisfactory condition. Apples exported to the London and Vancouver markets commanded high prices. The Viticultural Expert states that the gradual improvement in the quality of the wines produced in the State is every year more noticeable. The seventeenth annual report of the Hawkesbury Agricultural College is also included.

Annual Report of the Forestry Branch, 1907–08.—This report deals with the period July 1, 1907, to June 30, 1908, and states that although the timber export trade, compared with that of the previous year, shows a decrease, the revenue derived from royalties, licences, etc., indicates an all-round expansion of the timber industries. Additional tests have been in progress in the Russell Engineering Laboratory of Sydney University, in order to ascertain the strength and suitability of the chief timbers for engineering and building purposes.

On June 30, 1908, the total area included in reserves for preservation of timber was 7,155,902 acres, showing a decrease of 300,143 acres in comparison with the figures of June 30, 1907. The stock of plants at the State Nursery was well maintained, and 54,850 were distributed during the year. The output of native timber from logs amounted to 122,611,000 superficial feet, valued at the mills at £748,544. The trade in sleepers showed a decrease in comparison with the preceding period. The question of the suitability of "bloodwood" for sleepers came under notice, and as this is a plentiful timber, not in large demand for other purposes, it was decided to obtain representative samples and submit them to preliminary exposure tests. An interim report of the Royal Commission on Forestry, appointed in March 1907, is issued as an appendix, and the report of the Government Botanist is also included.

Report on Botanic Gardens and "Government Domains," 1908.—The Report is a record of twelve months' work in this department, including the Botanic Gardens, the National Herbarium and Botanical Museum, the Library, Government Domains and Garden Palace Grounds. Four

photographic illustrations, two of the Botanic Gardens, one of t Government Domain and one of the Centennial Park, are given.

Agricultural Gazette, 1910, **21**. Part 1.—Some hints on the manufac ture and management of chaff—A suggested new industry for Nev South Wales farmers (this suggests the cultivation of the snapping turtle of Japan, *Trionyx japonicus*, which is now imported in considerable quantities to New South Wales, to be used in place of the large marine green turtle used in the preparation of turtle soup. A description of the method of cultivation followed in Japan is given)—Ensilage—Maize smut (a brief description of this fungus *Ustilago maydis* and methods of dealing with it)—Grasses and fodder plants (continued from previous numbers. In this section lucerne, red clover, burnet and black medic are described and analyses given)—The world's wheat supply (gives the production of wheat for the period 1904—1908. The maximum 3,349,140,706 bushels was reached in 1905, and the minimum for the period 3,118,075,812 in 1907)—Packing apples for export—Smut in wheat (gives a brief *résumé* of experiments made in Tasmania since 1892 with the varieties of wheat commonly grown there. The principal point established is that infection with the loose smuts of wheat and barley takes place only at the time of flowering)—Cultural methods for wheat-growing in dry districts, Part III. Rotation of crops—Devices for maize-husking. Part 2.—Wheat conference (gives a list of the varieties of wheat to be recommended for planting in 1910, with notes as to the time of planting in the various districts)—Soils of New South Wales. Part I. Soils of the South Coast—Analyses of some grasses and fodder plants grown in New South Wales (gives complete analyses of a large number of typical fodder grasses)—Bare patches, heir causes and treatment (it is shown that in certain cases the sterility s associated with a considerable excess of manganese in the soil, and n other cases with the presence of calcium chloride)—Manure experinents at Bathurst Experimental Farm—Plant bug pests—Notes on he early growth of wheat. Part 3.—The varieties of wheat recomnended by the Department of Agriculture (gives descriptions of the edigree, habit of growth, etc., of the varieties recommended)—Brown ot of fruit (a description of the disease is given, and cutting out of the ffected parts is recommended together with the spraying of the trees rith dilute Bordeaux mixture in early spring)—Note on the occurrence f manganese in soil and its effect on grass (points out that the bare atches sometimes found in grass land are due to the presence of nanganese in the soil)—Trials of methods of soil culture (the results how that the yield from plots in which the surface soil had been horoughly tilled was greater by from 20–66 per cent. than in similar lots in which the surface was in clods)—The house-fly and the iseases it spreads—Spraying (a general article on the spraying of fruit ees for insect and fungoid pests)—Experiments with nitric acid on lkaline soils in the Coonamble district—Artesian irrigation. Part 4.

—Mudgee-Dunedoo district (gives a description of the soils, rainfall etc., of this district, to which the railway line has just been extended and which, it is believed, will be suitable for wheat-growing)—Varieties of wheat recommended by the Department of Agriculture (continued from the previous number)—Experiments with fungicides for the prevention of "bunt" in wheat (the best results were obtained by the use of (1) blue stone and salt, (2) fungusine. The treatment recommended is to steep the grain for sowing, in a solution containing 2 lb of bluestone and 2 lb. of salt in 10 gallons of water. The seed should be immersed in this liquid for 5 minutes and then taken out and dried) —Insectivorous birds of New South Wales—Bush fires—Mangels, Mangolds or Mangel-wurzel (describes the cultivation of this root-crop) —Fertilisers in New South Wales (a list of the manures available in the State is given, with values and composition as guaranteed by the makers)—Worm infestation in lambs—Willows as stock food and shade in summer—Friendly insects—Artificial brooding of chickens—The strawberry (gives information on cultivation, varieties, packing and marketing).

NEW ZEALAND.

Department of Agriculture, Chemistry Division. Annual Report, 1909.—The total number of analyses made was 4,546, mainly of milk, butter and fertilisers in connection with legislation affecting the Dairy and Fertiliser industries. Great interest is being taken in the exploration for phosphate deposits now being carried on throughout the Dominion, and in this connection ninety-six samples were examined, but no considerable deposit of value has yet been located.

A number of poisonous plants were examined including *Senecio Jacobæa*, Strathmore weed (*Pimelea* sp.), *Ocotea* sp., *Cyperus rotundus*, *Discaria toumatou*, and notes on these and other poisonous plants of the Dominion are given. The work on soils, to which reference was made in the report for 1908, has been continued, and a detailed account is given of investigations of (1) humus soils of the Southern Islands, (2) Ohinemuri Silt (tailings from gold mines), (3) Pakihi soils of Westland, and (4) Magnesia soils of Nelson. A large number of analyses of root-crops including beet, turnips, and mangolds were made and tables of the results are given.

Mines Department, Dominion Laboratory. Forty-Second Annual Report, 1908.—The number of samples examined was 1,530. These included coals and carbonaceous minerals, sands and clays, limestones and cement materials, phosphates, iron ores, copper ores, ores of molybdenum, antimony, manganese, tungsten, lead, zinc and mercury, and various rocks containing platinum, silver or gold. Among these last was a sand from Arthur Creek, Westland, containing 2 dwt. 12 grains of platinum and 1 dwt. 16 grains of osmium-iridium per ton. Another sand from the same locality showed 4 oz. 16 grains of platinum and 1 oz. 4 grains of osmium-iridium per ton. Other sands from

Westport contained 2 dwt. 12 grains and 1 oz. 3 dwt. 22 grains of platinum per ton. A number of samples of mineral and potable waters were also analysed. Six samples from the Whatatutu District consisted of organic matter containing petroleum. Samples of the crude petroleum obtained at Waitangi Hill were also examined. These consisted essentially of "burning oil" (150–300° C.) and "heavy oils" (distilling above 300° C.).

BRITISH GUIANA.

Journal of the Board of Agriculture, 1910, **3**. No. 3.—Some local aspects of co-operation.—The experimental error in field trials (gives calculations of the possible error in the manuring experiments carried out with rice during the last six years, and with cocoa during the last four years in British Guiana)—The large moth-borer on sugar-cane (gives a reprint of a memorandum which has been circulated to estates with the view of obtaining information as to the life-history of this pest).

WEST INDIES.

Imperial Department of Agriculture, Pamphlet No. 63.—Seedling and other canes in the Leeward Islands, 1908–09. No. 64.—Manurial experiments with the sugar-cane in the Leeward Islands, 1908–09.

West Indian Bulletin, 1910, **10**. No. 3.—Legislation in the West Indies for the control of pests and diseases of imported plants (an account of the progress of legislation for the purpose of controlling plant importations. The existing legislation in each of the islands and colonies is described and compared)—Fungi causing diseases of cultivated plants in the West Indies (a classified list with short descriptions of the fungi and references to literature)—Manurial experiments with cotton in the Leeward Islands—The rainfall of Nevis and Antigua.

TRINIDAD. *Bulletin of the Department of Agriculture*, 1910, **9**. No. 4.—Analyses of Tobago soils—Rubber cultivation in Trinidad and Tobago—Preliminary report on cacao-spraying experiments (gives the results of spraying with "Bordeaux mixture" and "lime-sulphur wash" with a view to ascertaining the effects of these on buds, flowers, fruit and leaves of the cocoa plant. Bordeaux mixture was found to destroy buds and flowers and to injure young leaves to a slight extent, but had very little ill effect on fruits and old leaves. Lime-sulphur wash was injurious to buds and flowers, but innocuous to leaves and fruits, and at dilution of 1 to 30 scarcely injured even buds and flowers)—Frog-hoppers in sugar-cane—The bud rot of the coconut palm—The serious coconut palm diseases in Trinidad—Cacao canker—The Witchbroom disease of cacao in Surinam—The relation of black rot of cacao pods to the canker of cacao trees—*Flemingia stobilifera* (suggested as a cover-plant for cultivation in Trinidad. Analysis shows that the ash contains nearly 11 per cent. potash, 16 per cent. lime, and 7 per cent. phosphoric anhydride, the nitrogen ranging from 0·75 per cent. in the stems and branches to 2·67 per cent. in the leaves).

Department of Agriculture, Cacao Circular, No. 1.—Describes the ingredients and preparation of "Bordeaux mixture" and a number of simple tests designed to exclude the use of impure and inferior materials.

BARBADOS. *Imperial Department of Agriculture. Report on the Local Department of Agriculture*—1908–09.—The Report gives details of the very large number of economic plants distributed during the year. Experiments were conducted with sugar-canes on fourteen estates, and in addition there are in progress co-operative experiments on other estates. Full particulars of the results of this work have been published separately. The yield of cotton per acre in Barbados has decreased from 240 lb. per acre in 1905–06 to 170 lb. in 1906–07, and 137 lb. in 1907–08. The causes are unfavourable climatic conditions, and attacks by insect pests. Starting with "Sea Island" and "Silket" varieties, selection experiments are now in progress with a view to the production of a variety giving higher yields. A large number of kinds of sweet potatoes and cassava are also under trial, with a view to ascertaining which will give the best yields.

DOMINICA. *Reports on the Botanic Station, Experiment Plots, and Agricultural School*, 1908–09.—The economic plants under trial include Para, Lagos, Ceará, Rambong and other rubbers. The work of grafting cocoa is being continued, and 246 plants have been distributed and a number planted at the Station. *Theobroma pentagona* grafts on Forastero stocks have given promising results, and 400 of these have been distributed to estates for experimental cultivation. The export of cocoa was 9,820 cwt. as against 11,628 cwt. in 1907, the falling off being due to (1) a shortage of the crop, and (2) the lateness of the Christmas crop, which could not be gathered in time for export in 1908. The manuring experiments on cocoa started in 1900, on the plots attached to the Station, have been continued, and detailed tables are given showing the advantages in yield per acre resulting from various methods of manuring. The best results were obtained by the use of grass and weeds as a mulch, and the next best by the application of a complete manure containing nitrogen, potash and phosphates. The results of similar manurial trials on cocoa plantations in other parts of the island are also given. On the experiment plots attached to the Agricultural School trials of varieties of ground-nuts were made, and experiments with various fodder grasses were continued.

JAMAICA. *Bulletin of the Department of Agriculture*, 1910, I. No. 3.—Tick and other blood-sucking arthropoda of Jamaica—Tea in Jamaica (an illustrated article describing the history of its introduction and the methods of cultivation and preparation adopted in Jamaica)—History of the introduction of the economic plants of Jamaica—Seedling canes on the North side—Practical measures for the prevention of ticks in Jamaica.

CANADA.

Department of Agriculture. Branch of the Seed Commissioner. Farm Weeds of Canada. Second Edition, 1909.—The principal weeds of Canada are described, members of the same family being taken together. The grasses are represented by *Setaria viridis, Hierochlöe odorata, Avena fatua, Bromus secalinus, Lolium temulentum, Agropyron repens, Hordeum jubatum* and their allies. A short description of the habit of the plant and of the seed is given in each case accompanied by a coloured plate of the species. The time of flowering and the distribution in Canada are recorded, and short paragraphs giving the injury done by the weed and remedial measures against it are printed. In an introductory section the harm done by weeds is discussed in a general manner, and the general principles underlying methods for the eradication of weeds are discussed. Many of the species described are cosmopolitan, so that the book has a wide application outside Canada.

Department of Agriculture. Central Experimental Farm. Bulletin No. 62.—Strawberry culture (gives a description of the method of planting strawberries with notes on varieties, times of ripening, and information regarding the principal insects and diseases affecting the plant).

Botanical Division, Bulletin No. 63. *A serious potato disease occurring in Newfoundland.*—Gives a *résumé* of information regarding the disease variously known as "Black scab," "Warty disease," or "Potato Canker," which has been prevalent in European countries during the last thirteen years and has now made its appearance in Newfoundland. A history of the disease is given since its discovery in 1896; its appearance in the field is described, and methods of dealing with it are indicated. Total destruction of the diseased crop is recommended, but tubers not obviously diseased may be collected, boiled and fed to pigs. Seed potatoes should not be obtained from disease-infected localities, and if there is any doubt as to the soundness of seed potatoes, they should be covered with powdered sulphur and stored in this condition till planted. No. 64. *Results obtained in* 1909 *on the Dominion Experimental Farms from trial plots of grain, fodder, corn, field roots and potatoes.*—Tables are given showing (1) the average yield during the last five years, (2) average number of days taken to mature, and (3) yield in 1909, of a large number of varieties of wheat, oats, barley, maize, peas, turnips, mangels, carrots, sugar-beets, and potatoes at the several experimental farms in the Dominion. The results are thus of great interest in indicating the varieties of these crops best suited for cultivation in different parts of Canada. This series of experiments has now been in progress for fifteen years. As indicating the importance of experiments of this kind the following average yields per acre given by "Red Fife" wheat at the various stations may be quoted. Ottawa (27 bush.), Nappan (28 bush. 42 lb.), Brandon (41 bush. 14 lb.), Indian

Head (32 bush. 24 lb.), Lethbridge (31 bush. 25 lb.), Lacombe (16 bush. 25 lb.), and Agassiz (26 bush. 55 lb.). The days required by this variety to ripen, range in like fashion from 132 days at Indian Head to 103 days at Ottawa.

Department of Mines, Mines Branch. Report on the Iron-ore Deposits along the Ottawa (Quebec side) and Gatineau Rivers. No. 23.—The iron ores described in this report are principally magnetite, less commonly hæmatite or a mixture of the two. In character and mode of occurrence they resemble the Scandinavian ores. They occur in Laurentian rocks, especially in the crystalline limestones, though the gneisses and schists also contain ore. The ores are always low in phosphorus and sulphur; titanium also is usually low, though in some cases it rises as high as 10 per cent. The principal minerals associated with magnetite in the limestones are stated to be serpentine, pyroxene, hornblende, tremolite, "elastonite," mica, graphite, apatite, quartz, scapolite, iron pyrites, zircon, spinel, fluorspar, tourmaline, and copper pyrites. All attempts hitherto made to mine the ores of this district have been abandoned. The cause of failure in some cases was incompetent management, in others, lack of fuel and transport facilities, but the chief cause was the want of efficient methods of concentrating lean ores. It is noteworthy that the important magnetite mines in the Adirondacks could not at first be worked successfully owing to the same cause. It seems, however, that if modern methods are employed it would be possible to found an important iron-smelting industry in this portion of Quebec, especially in the Bristol and Hull districts. A large part of the country is covered by a second growth of forest, which would furnish sufficient firewood and mining timber for some time to come. Moreover, abundant waterpower is afforded by the two rivers which traverse the district. Cheap electric current could thus be obtained, not only for mining operations but also for the electric smelting of the ore when brought to the surface.

An appendix to the Report describes in detail the falls and rapids on the Ottawa and Gatineau rivers, with the estimated horse-power to be derived from each. The total minimum horse-power available at low water on the two rivers, within the district dealt with, is over half a million. The Report is illustrated by plates, maps and plans.

Ontario.

Annual Report of the Department of Agriculture, 1908, Vols. I. and II. —This report is arranged on much the same lines as that of the previous year (this *Bulletin*, 1909, 7. 231), and contains *résumés* of the work done by the Agriculture College and Experimental Farm and by various Agricultural Associations during 1908.

GENERAL COLONIAL AND INDIAN PUBLICATIONS.

In the following paragraphs a summary is given of the more important contents of the chief Colonial and Indian periodical publications received recently at the Imperial Institute, in so far as these relate to agriculture or to economic products and are likely to be of general interest.

UGANDA PROTECTORATE.

Official Gazette, 1910, 3.—No. 44 contains extracts from the Tobacco Expert's Report, December 1909. About 103,000 seedlings of Cavalla tobacco had been transplanted. The weather during the month was cloudy and wet, and the seedlings first planted out suffered severely from mildew, and to a less extent from wireworm. Tobacco seems to do best on the higher ground near Kampala, and next season a larger area in such situation will be planted. No. 45.—The Tobacco Expert reports that in January 1910 further damage was done by mildew. Out of 115,000 seedlings, no less than 20,000 had to be destroyed owing to damage caused by this fungus. The remainder of the crop appears to be in very good condition. Some damage was done by a gale, accompanied by hail, on January 31, but although many plants were blown down, it has been possible to replant these without serious loss, though many of the leaves were riddled by the hailstones and will be useless for curing. No. 47.—Wheat industry (reprints a report by the Imperial Institute on a sample of wheat grown at Toro, and mentions that the District Commissioner of Toro has stated that "Rietta" wheat imported from the East Africa Protectorate for trial has not given good results, though "Gluyas" seed gave a satisfactory crop)—Cotton industry (a report on the state of the industry in the Bukedi district). No. 48.—Mosquitoes and their relation to malaria (a short article on mosquitoes as a host of the malaria parasite, with notes on the habits, life history, and methods of controlling and destroying mosquitoes). No. 49.—Tobacco culture (an extract from the report of the Tobacco Expert for February 1910).

NYASALAND.

Government Gazette, 1910, 17. No. 1, *Supplement*.—Some notes on tree-planting in the Shiré highlands of Nyasaland. The indigenous trees are mostly small slow-growing hardwoods and shrubs, and as timber is becoming scarce near the centres of European population a considerable amount of attention is now being given to varieties of exotic timbers suitable for introduction into the Protectorate. The trees recommended are of three classes, (1) durable hard-woods, mainly species of Eucalyptus, (2) durable soft-woods, such as West Indian cedar, Norfolk Island pine and Kauri pine, (3) indigenous timber, Mlanje cypress, African mahogany and trees for ornament and shelter belts including the Candlenut tree, East India walnut, camphor, pencil

cedar, black mulberry, mango and many others. It is pointed out that Nyasaland is generally too hot and dry for black wattle culture. No. 2.—Notes on bacterial blight in cotton. (This disease, *Bacterium malvacearum*, has caused a considerable amount of damage to Egyptian cotton crops in Nyasaland. The symptoms are described and remedial measures suggested. In the latter connection attention is directed to the necessity of avoiding low-lying land near the river for the cultivation of Egyptian cotton, the uprooting and burning of the stems after the cotton has been picked, the avoidance of cultivating cotton by ratooning and the desirability of using seed disinfected with corrosive sublimate or formalin solution.)

SOUTHERN NIGERIA.

Government Gazette, 1910, **5**. No. 11.—This contains the Agricultural Bulletin for the quarter ending September 30, 1909. In the Forestry report for the Eastern Province for the half-year ending June 30, 1909, it is mentioned that a large quantity of the thin-shelled variety of palm nuts (this *Bulletin*, 1909, **7**. 376) has been collected for distribution as seed. Large quantities of Para rubber seed and seedlings were also distributed. An address by the Government Entomologist to the Egba Farmers' Association on the subject of insect pests attacking cocoa trees is reprinted. Extracts from the half-yearly report on the Western Province show that the production of cotton lint greatly exceeds that of the previous year. Experiments with maize and various fibres, including Mauritius hemp, *Urena lobata*, Sisal hemp, *Sansevieria guineensis*, etc., are in progress. Particulars of rubber tapping experiments, carried out with *Funtumia elastica* trees in the Mamu reserve, are published. The best yields were obtained by spiral tapping, and the next best by long vertical cuts. The results indicate that in this species the yield of rubber from the trees decreases steadily with successive tappings.

Details are also given of tapping trials with *Hevea brasiliensis* and *H. spruceana* in a plantation at Orugbo and in the Botanical Gardens at Ebute Metta.

A report by the Government Entomologist on the Eastern Province shows that cotton at Abakaliki Station was badly attacked by "mealy bug" (*Dactylopius* sp.), and it was recommended that the plants should be destroyed to prevent further infection by the pests. Cotton is being very well grown at Ajala, and the fields there were free from pests.

GOLD COAST.

Colonial Reports. Miscellaneous. (Cd. 4,993.) *Report on Forests.*—Early in 1908 Mr. H. N. Thompson, Conservator of Forests in Southern Nigeria, was commissioned by the Government of the Gold Coast to inspect the forests of the Colony, and to report on the means to be taken to regulate the haphazard methods of exploiting them,

especially for mahogany. The resulting report is a very valuable contribution to the literature on African Forests. Part I. describes the principal afforested areas of the Gold Coast and of Ashanti. It is clear from this section that the Colony and its Protectorate still possess splendid forests, which, properly exploited, should form a source of great wealth in years to come. A great deal of damage has been done already, principally as the result of indiscriminate clearing to provide land for the primitive and wasteful methods of cultivation employed by the natives, and to a less extent through the felling operations of timber exporters, and immediate action is necessary, especially in certain areas, to prevent further destruction of forests. It is noted that at some points serious changes in climate are already noticeable as the result of forest destruction, and the menace to the agricultural industries of the Colony, which will result from further extensive clearings, is pointed out. Full notes are given as to the occurrence of species of economic value; these include timber trees yielding mahogany, cedar, African oak, and other valuable woods, trees yielding oil seeds such as *Lophira alata* and *L. procera*, shea butter tree, *Carapa* spp., *Pentaclethra macrophylla*, *Mimusops* spp., etc., various rubber trees, fibre-yielding plants, trees yielding edible fruits, and other less important products.

Part II. gives a general discussion of the whole question of forest protection and forest legislation, with special reference to the conditions obtaining in Southern Nigeria and the Gold Goast. The latter Colony present special difficulties to conservation, since the forests are the property of the native communities, and it is notoriously difficult to get effective forest protection in such cases. A comprehensive scheme for a Forest Department, and for the introduction of Forest Conservation in the Gold Coast, is given in detail.

In Part III. a description of the physical features, climate, etc., of the Gold Coast and Ashanti is given with notes on the characters of the forests and their climatic relationships. This section also contains a useful list of the native names of some of the principal forest trees, presenting features of special interest.

ST. HELENA.

Colonial Reports. Miscellaneous, No. 69. *Report on the Fisheries of St. Helena.*—Gives an account of the experiments carried out at St. Helena early in 1909 by Mr. J. T. Cunningham, M.A., F.Z.S., at the suggestion of Mr. A. Mosely, C.M.G., with various kinds of nets with a view to ascertaining whether more remunerative methods of fishing could be substituted for those now in vogue in the island. It is considered that the methods used in the French sardine fishery would probably answer well for mackerel (*Scomber colias*) in St. Helena. Several barrels of mackerel were prepared and sent to the United States for valuation. They were described as of good quality, but at the time they were placed on the market there was a glut of fish, and conse-

quently prices were low. It is considered, however, that there would be a good market for St. Helena cured mackerel in the United States in normal seasons. Particulars of the fishery for other St. Helena species such as "albacore" (*Zhynnus alalonga*), "stonebrass" (*Caranz sanctæ helenæ*), "old-wives" (*Sargus capensis*), and others are also given.

NOTICES OF RECENT LITERATURE.

NEW BOOKS.

WOBURN EXPERIMENTAL FRUIT FARM. Eleventh Report. By the Duke of Bedford, K.G., F.R.S., and Spencer U. Pickering, M.A., F.R.S. Pp. vi. + 191 + xxi. (London: The Amalgamated Press, Ltd., 1910.)

This Report, which is probably one of the most important yet issued from the Woburn Farm, deals with the extremely difficult subject of the constitution of the various fungicides having copper compounds as a basis, and offers some explanation of their mode of action.

Any adequate discussion of these matters must of necessity be given in language full of technical terms, and consequently the authors point out in their introduction, that in this case they are not attempting to write directly for the fruit-grower, who must as a rule be content to accept the practical outcome of such work as this without attempting to follow in detail the actual experiments made.

It should be noted that the summary of results included in the report (p. 180–190) which is also sold separately, gives an excellent *résumé*, simply expressed, of the information obtained in the course of these investigations, and the fruit-grower may consult this with advantage for practical details as to the best and most economical methods of using copper fungicides.

It is not at first sight clear that an elaborate chemical investigation of the copper compounds existing in fungicides as applied to diseased plants, is likely to yield results of practical value, and the authors are to be congratulated, not only on the ingenuity of their work and the results obtained, but also on this fresh demonstration of the practical utility of apparently abstruse scientific investigations.

The fundamental problem is to find a substance which will act as a poison to the fungus, but as both the fungus and its host are vegetable organisms, about equally sensitive to the action of the poison, the latter must be applied in such a way as to exercise the maximum action on the fungus and the minimum action on the host. Further, to be useful the poison must be in a soluble form and at the same time must not be readily washed off by rain. Finally, there is the actual mode of

action of the poison on the fungus to be considered. As regards the second of these points a practical solution is found in applying the copper compound in the form of "Bordeaux mixture," which as the authors have shown, consists when properly made of a complex mixture of basic sulphates of copper. The latter on exposure to air are gradually decomposed, forming copper carbonate and copper sulphate, the last-named being the ultimate effective fungicide. Stated in this way it becomes clear that the proportions in which lime and copper sulphate are employed to form "Bordeaux mixture" must profoundly affect the fungicidal efficiency of the product, and the authors find that, by proper attention to this point, a product 20 times as efficient as ordinary "Bordeaux mixture" can be made, and they have drawn up specifications for a paste which, when mixed with the proper quantity of water, will yield a fungicide at least 12 times as efficient in practice as the ordinary mixture. Of the other copper fungicides tried none appears to present any advantages over a fresh well-made "Bordeaux mixture."

A large number of practical points connected with the application of copper fungicides have also been investigated. Thus it has been shown that the prevalent idea that the action of "Bordeaux mixture" does not come into play for many days after its application, is erroneous, and that the action takes place at once, although the effects do not become visible until the tissue has had time to decay. The "scorching" of foliage which accompanies the application of efficient fungicides is also fully dealt with. The addition of substances to copper fungicides with a view to increasing their power of adhesion to leaves is not recommended since many experiments with such products as "quillaia bark extract" gave negative results. Nicotine may, however, be added to "Bordeaux mixture" without detriment, and this is often a useful addition when plants affected by both insect and fungoid pests have to be treated.

The points referred to above are only a few of those fully investigated and discussed in this report. The latter is primarily intended to afford information which will be of benefit ultimately to fruit growers in the United Kingdom, but the results will be of far wider application than this, and throughout the Colonies and India this publication will be welcomed by officials of Agricultural Departments in charge of work on the eradication of fungoid pests.

ELEMENTS OF PHILIPPINE AGRICULTURE. By E. B. Copeland, Ph.D. Pp. xvi. + 192. (New York and Manila: The World Book Company, 1908.)

Agriculture in the Philippines is at present in a backward state. To quote Dr. Copeland, who is the Superintendent of the Insular Agricultural School, the yield of sugar is at the rate of about one quarter that of Hawaii from no better soil, of coconuts about half that

of Ceylon: sweet potato and maize are very poor, cassava is neglected and starch has to be imported from America. School tuition alone in agricultural principles will not revive the agriculture of a country, but, as has been recognised in some of the British Colonies, it can play an important rôle if theoretical and practical work are wisely combined. This book has been prepared to achieve this aim. Introductory general matter on animals and plants, the soil, elements of plant physiology, climatic conditions in the Philippines, and pests, is followed by fairly detailed, but simple, descriptions of the principal stages in the cultivation and preparation of the chief local crops. Attention is frequently directed to improved methods practised in other countries.

There are a few statements which call for notice. On page 4: plants, because they are stationary, are said to have rigid cell walls, whilst animals which must move have no such rigid walls. This is not a valid distinguishing feature between the two groups. Coconuts and their products are not the chief exports from Ceylon (p. 126). To explain why kapok fibre is not spun and woven, it is not adequate to say that "it is too curly to be used in making cloth" (p. 149). On page 170, in discussing cocoa we find "Much iron in the soil is an advantage, because it darkens the seed and dark seed brings a better price." It may be noted that in comparative analyses by J. B. Harrison of West Indian cocoa soils, the ferric oxide in the "good" soils ranged from 3·9 to 9·5 per cent.; in the "poor" soils from 3·8 to 22·3 per cent. More exact definition is desirable of what is meant by "much iron." The amount of iron in the cocoa bean is very small, about 0·03 per cent. in the fresh seed, and proof that it and the colour of the bean vary in relation to the amount in the soil would be of interest.

On the whole, the book should serve very well the purpose for which it has been designed. It is clear, simply written, and the practical notes and suggestions should be of value to the teacher.

MANUEL PRATIQUE DE LA CULTURE DU CAFÉIER ET DU CACAOYER AU CONGO BELGE. Pp. 96. (Brussels: Van Campenhout Frères et Sœur, 1908.)

In the humid districts of the Congo the introduced *Coffea liberica* thrives and is cultivated with success. The closely related, indigenous species *C. Dewevrei*, *C. Arnoldiana*, *C. aruwimiensis* and *C. Royauxii* also do well under similar conditions. To drier regions, *C. canephora*, *C. Laurentii* and *C. robusta*, also indigenous, are better suited, whilst *C. congensis*, var. *Chalotii*, thrives on moist, or even at times inundated lands.

Cocoa, the second plant dealt with, was introduced in 1887. The variety principally cultivated is described as Forastero-Amelonado, obtained from San Thomé.

In this book, which is a publication of the Ministère des Colonies, a general account is afforded of the cultivation of each, and the prepara-

tion of its products. The habit pictures are good, and there are in addition diagrammatic sketches of machines, modes of irrigation, and miscellaneous appliances.

FERTILISERS AND MANURES. By A. D. Hall, M.A., F.R.S., Director of the Rothamsted Experimental Station. Pp. xvi. + 384. (London: John Murray, 1909.)

This book is a companion to the volume on *The Soil*, by the same author (reviewed in this *Bulletin*, 1903, 1. 215), and is to be followed by one dealing with the chemistry of the growing plant; it is to be hoped that Mr. Hall will add one on the nutrition of the live stock of the farm, and thus cover the whole range of agricultural chemistry. It is not easy to speak too highly of the present work; in it the lessons to be learnt from the sixty years and more of field experiments made at Rothamsted by Lawes and Gilbert are lucidly stated, and the causes of the results observed are simply and clearly explained. Not only are the principles elucidated, but their application to particular crops and soils is given in the form of practical directions. The reader is told how much fertiliser to apply, when to apply it, and further, when not to apply it in cases where the return in the form of increased crop would be of less value than the cost of the manure, or owing to its producing a deleterious effect.

To consult the Rothamsted records and endeavour to master the bearings of the facts recorded in the apparently endless tables is a formidable task; but in this book only comparatively few tables are given, and these are not overburdened with figures, only those bearing on the point under discussion being given, and that in a simple form.

As the book is intended for users of fertilisers not much is said about their manufacture and analysis, but a chapter is devoted to their valuation and purchase. Although the book deals mostly with English crops, some pages are given to the manuring of tropical and sub-tropical crops, including tea, tobacco, cotton, and sugar-cane.

COMMERCIAL PEAT, ITS USES AND POSSIBILITIES. By Frederick T. Gissing. Pp. x. + 191, with 59 illustrations. (London: Charles Griffin and Co., Ltd., 1909.) To those who have not followed the recent developments in the utilisation of peat, the variety of the commercial applications of this once despised material, which are described in this book, will come as a complete surprise. The author first describes the methods of manufacturing alcohol from peat for use as a substitute for petrol, which is rapidly rising in price. The peat, wet as it comes from the bog, is mixed with water, acidulated with sulphuric acid and boiled under low steam pressure for a little over half-an-hour, long enough to convert the starch and gum, but not the cellulose into sugar. The excess of acid is then neutralised by lime or a clay often found at the bottom of peat bogs, containing calcium carbonate as well as phosphoric acid, magnesia and nitrogen. These constituents assist the growth of

the ferment, which has been obtained from berries frequently found growing on the surface of the bogs. A clear liquid, containing the alcohol produced, separates out and is acidulated and employed instead of water for boiling with fresh peat, the alcohol and aromatic products being distilled off at the same time. The solid sediment yields, as dry distillation products, gas for fuel, ammonia solution for making ammonium sulphate, paraffin, creosote, oils, methyl alcohol, tar and other products which are usually obtained from peat independently of the production of alcohol, by processes which are fully described by the author. A great deal of the value of the peat depends on the percentage of nitrogen present, which determines the amount of ammonia which can be obtained. Peat may also be employed to form a "nitre bed" for the production of nitrates, both from the original nitrogen of the peat itself and from added ammonium sulphate, over which peat exercises a powerful "nitrifying" effect.

Another interesting method of utilising peat is to convert it into "coal" by the "wet-carbonising" process. The disintegrated peat is forced in a continuous stream through an oven heated to between 180 and 230° C. (the author has Fahrenheit, but this is evidently a misprint) under a pressure of from 200 to 300 lb. per square inch. Partial carbonisation occurs, and, as the slime-like hydrocellulose is destroyed, the water can be easily pressed out. The residue is converted into briquettes closely resembling lignite, which burn with a long clear flame, retaining their shape till consumed. On dry distillation they give good gas and coke. This product has an important advantage over natural coal in being free from sulphur.

A useful "water gas" can be obtained direct from wet peat by destructive distillation. Other valuable products, including coke, ammonium sulphate, calcium acetate, tar, tar oils, and lubricating grease, are obtained at the same time. Peat has also been employed in combination with other materials in the formation of beds for the bacterial treatment of sewage.

The author describes the manufacture, from peat, of brown paper which can be used for wrappers, and as a result of its aromatic character protects material such as furs from the attacks of insects. Strong cardboard and paperboard can also be produced. The excavation, disintegration, drying and compressing of peat and its preparation as fuel are also dealt with as well as the reclamation and cultivation of peat lands. The author concludes with a brief account of the principal peat deposits of the world, and a bibliography of the subject.

The book should be read by all who are interested in areas where peat is found. If it has a fault, it is that the author is content to describe rival processes without instituting comparisons as to their relative value, thus leaving the reader to form his own opinion as to which is the more economical and practicable.

ANTIMONY: ITS HISTORY, CHEMISTRY, MINERALOGY, GEOLOGY, METALLURGY, USES, PREPARATIONS, ANALYSIS, PRODUCTION, AND VALUATION, with complete bibliographies. By Chung yu Wang, M.A., B.Sc. Pp. x. + 217, illustrated. (London: Chas. Griffin and Co., 1909.)

This treatise is a welcome addition to special metallurgical literature, since previous to its issue there was no comprehensive work in English on antimony. After discussing briefly the history of the metal, the author deals with its chemistry, metallurgy, uses and valuation in a very thorough manner.

The book includes a feature which might be more generally adopted with advantage by writers on technical subjects, viz. that each chapter is concluded with a bibliography of the subject discussed therein.

This book is clearly and well written, and should prove of value to all interested in antimony, either from its mining or metallurgical side.

"ELECTRO-MAGNETIC ORE SEPARATION." By C. Godfrey Gunther. Pp. vi. + 193. (New York and London: Hill Publishing Company, 1909.)

This is a useful book and meets the need, which many readers must have felt, of a handy, up-to-date treatise on the subject of electro-magnetic ore separation. In his preface the author states that "this book has been prepared to gather into convenient form the published information on the magnetic separation of ores. The compilation has been supplemented by data from the writer's observation and an extensive correspondence with mill managers and manufacturers. It has been attempted to include only that which is of present commercial importance."

In a brief introduction of about one page, the author is content merely to hint at the fact that magnetic processes of ore separation have a long history behind them. They were originally applied only to the concentration of magnetic iron ore, and a patent was granted in England for this purpose as early as 1792. For these early processes, permanent magnets gave a sufficiently strong field, but they are quite incapable of application on a large scale to the more general case of the extraction of weakly magnetic minerals. For this purpose the stronger field of an electro-magnet has to be used, and numerous different kinds of electro-magnetic machines have been devised and patented to extract weakly magnetic minerals such as garnet, wolframite, ferriferous zinc blende and monazite, which cannot be extracted on a commercial scale by permanent magnets.

Chapter I. deals briefly with the phenomena of magnetism as bearing on mineral separation. Chapter II. enumerates the principles involved in the manipulation of the electro-magnet, and also describes the manner in which the ore is prepared for treatment. Chapters III. and IV. are

devoted to descriptions of the different kinds of machines employed in the dressing of strongly and weakly magnetic ores.

The remaining four chapters give examples of the application of the previously described principles and machines to the chief problems of ore-dressing. Chapter V. deals with magnetite ores; chapter VI. with blende and pyrite; chapter VII. with siderite and blende; and chapter VIII. with various miscellaneous ores and minerals, including monazite.

On p. 171 in the last chapter, garnet, menaccanite, rutile and zircon are mentioned as the commoner impurities of monazite sand, and the following statement is made:—"The above-mentioned contaminating minerals are all magnetic in different degrees; menaccanite the most strongly magnetic, followed by zircon, and rutile being the most feebly magnetic; garnet varies considerably in its magnetic properties; all are more strongly magnetic than monazite." This is a very loosely written statement and it is quite inaccurate. Monazite is invariably more magnetic than rutile, and rutile than zircon.

The book is well illustrated, and on the whole concisely written. It is, perhaps to an unnecessary extent, free from that cumbersome detail which makes so many books of use only as works of reference; it could with advantage be amplified in many places, especially in the last chapter, in which some of the "miscellaneous" processes are too briefly dismissed. This defect will doubtless be minimised in future editions.

RAPID METHODS FOR THE CHEMICAL ANALYSIS OF SPECIAL STEELS, STEEL-MAKING ALLOYS AND GRAPHITE. By C. M. Johnson. Pp. vi. + 221. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.)

In this work the author describes in detail methods which he has found trustworthy for the estimation of vanadium, titanium, tungsten, molybdenum, chromium, copper, and nickel together with the usual methods for sulphur, phosphorus, carbon, silicon, etc., in steel. No mention is made of uranium or tantalum. Although many of the methods described are those commonly employed in steel works laboratories, several are new and noteworthy. Amongst these are (*a*) a qualitative colour test for titanium in the presence of vanadium; (*b*) the exact determination of phosphorus in ferro-vanadium (in the author's experience, the usual method may give as little as one-eighth of the total phosphorus present); (*c*) the estimation of silicon carbide in old plumbago crucibles; (*d*) the determination of small amounts of copper and nickel in ferro-vanadium by the use of potassium ferricyanide. The estimation of carbon is discussed in detail, over thirty pages being devoted to the various methods employed. The concluding chapters deal with the analysis of graphite and graphite crucibles and the annealing of steel. The book should prove of use to all engaged in the analysis of special steels.

THE MINING MANUAL, 1910. By Walter R. Skinner. Pp. lxxii. + 1455. (London: 1910.)

The present year's issue of this well-known publication maintains its reputation. It commences well, with a full index accompanied by detailed statistics of the crushing of gold quartz in different parts of the world. These are followed by particulars of the different mines with a list of officers, and information as to the financial position of each Company so far as it can be gathered from its published accounts. There is an Australian, an African and a Miscellaneous section, the last comprising Europe, Asia, and North and South America. This somewhat unsystematical arrangement is defended on grounds of convenience. Then come lists of mining directors, secretaries and engineers, and the volume terminates with a vocabulary of mining terms and a short appendix, which is intended to bring the information down to the end of the year 1909. The vocabulary might be revised with advantage. There is no entry under "pitchblende" or "uraninite" though this ore of uranium is attracting some attention as a source of radium, but "uranium" itself appears as "a metal of reddish-brown colour, commonly obtained in a crystalline form," information which is of no possible interest to the mining man. "Keuper" is described as the "upper part of red sandstone formation." The entry is hardly necessary in a book of this description, but if given at all it should have indicated that rocks with a definite stratigraphical position are designated by the term. "Hade" is described as the dip or angle of inclination of a vein, without any indication that the angle must be measured with the vertical.

The preface may be commended as a useful and interesting summary of the progress of the mining industry during the year.

REPORT ON THE MINES AND MINERAL RESOURCES OF NATAL. By F. H. Hatch, Ph.D., M.Inst.C.E., published by order of the Natal Government. Pp. xii. + 121. (Richard Clay and Sons, Ltd., London, 1910.)

At the suggestion of the Director of the Imperial Institute Dr. Hatch was recently requested by the Government of Natal to report on the mineral resources of the Colony other than coal. As the time available, only eight months, was so short, it was necessary for him to confine his work to a limited number of localities. The present publication, which is the first outcome of his investigations, commences with a brief account of the geology. The oldest rocks consist of a highly metamorphic series with great intrusions of granite and are referred to the Swaziland system of the Transvaal. They yield gold both in vein quartz and banket, iron in ferruginous quartz schists and "calico" rock, magnesia-bearing crystalline limestone and graphite. These are covered unconformably by the Table Mountain sandstone, which he identifies with the Waterberg of the Transvaal, and this again by

Karroo beds with coal, iron, phosphatic reefs and nodules, and a sandstone impregnated with marcasite-pyrites and molybdenite. Among other economic mineral products may be mentioned manganese, nickel (in pyrrhotite disseminated through norite, as at Sudbury in Ontario, and in Nyasaland), copper (in veins associated with syenite and serpentine), and asbestos (of the commercial or serpentine variety).

Up to the present none of the mineral deposits, with the exception, of course, of the coal, have given promise of important industrial developments. Much, however, remains to be done, and, as the author insists, the absence of a geological survey places serious difficulties in the way of scientific investigation of the mineral resources of the Colony.

In spite of the brief period of his stay in the Colony, Dr. Hatch was able to make an extensive collection in duplicate of the rocks and minerals. One series has found a place in the Pietermaritzburg Museum; the other has been presented to the Imperial Institute, where it will be placed in the South African Section of the Exhibition Galleries, and be available to the public for study and reference.

SOUTHERN RHODESIA. By Percy F. Hone. Pp. xvi. + 406. (George Bell and Sons, London, 1909.)

In this work, attention is restricted to the southern portion of Rhodesia; but some idea of the huge areas of South Africa is afforded by the note that Southern Rhodesia—a separate administrative unit—is two and a half times the size of England and Wales. The history of the region is well summarised, and prints are included of several interesting documents, *e.g.* the original agreement with Lo Benguela and the Royal Charter of the British South Africa Company. The main purpose of the book is to portray the natural features and resources of Southern Rhodesia, and to indicate the possibilities of the region and the probable lines of its future development. Those interested in these topics should peruse the book; suffice it to say, that Mr. Hone is distinctly sanguine as to the outlook. Many other important matters—railways, the native question, administration, etc.—are well dealt with, and the book as a whole affords a good summary of present knowledge regarding this interesting country.

CHEMICAL INDUSTRY ON THE CONTINENT. A report to the Electors of the Gartside Scholarships. By Harold Baron, B.Sc., Gartside Scholar. Pages xiv. + 71. (Manchester: at the University Press, 1909.)

The Gartside scholarships were established in connection with Manchester University in 1902. They are tenable for two years. Of this period a first portion must be spent by the scholar in study at Manchester University with a view to undertaking a special investigation of some industry, or part of an industry, on the Continent, or in the United States, in the later part of his tenure of the Scholarship. Each

scholar must present a report on the results of his study, and the present volume forms the eighth of the series of reports made by Gartside scholars.

Mr. Baron devoted his attention to the chemical industries of Belgium, Northern France, and Western Germany, and his information was obtained mainly by visits to works, or by means of interviews with directors and managers, in cases where works were not open to inspection. When it is remembered that the industries carried on in the region dealt with in the report include the manufacture of steel and iron, textile industries, especially the printing and dyeing of fabrics, the manufacture of artificial dyes and fine chemicals, alkali and sulphuric acid manufacture, petroleum-refining and cement-making, to mention only a few of the less specialised forms of chemical industry, it will be seen that Mr. Baron essayed rather a large task in the limited time at his disposal.

There can be no doubt of the value of an investigation of this kind, not only to the scholar who undertakes it, but also ultimately to the industries of this country, if those who secure these scholarships find their way into the technical staffs of manufacturing firms in the United Kingdom.

The present report affords an interesting view of the present position of chemical industry in the region indicated, but in view of the wide range of manufactures mentioned it is perhaps not surprising that the information is of a rather superficial character, except perhaps in the sections relating to dyes and to dyeing and calico-printing. The author's knowledge of some of the industries he describes is not so complete as is desirable; thus no one acquainted with that very important branch of chemical industry known as the manufacture of pharmaceutical preparations would speak of "medicinal extracts of various kinds, such as morphia and strychnine" (p. 9).

THE MANUFACTURE OF LEATHER. By Hugh Garner Bennett. Pp. xxi. + 420. (London: Constable and Co., Ltd., 1909.)

Although most of the information contained in the volume may be found elsewhere, a certain amount of new matter has been added, and the author has brought his material together in such a way that a good general survey of the many branches of leather manufacture is provided.

No attempt has been made to go beyond the limits of a text-book, and, as stated in the preface, the book has been written for the general student of this branch of chemical technology. The processes described are therefore all well known and established on a firm basis, and have been chosen generally as the most typical examples available. The opening chapters are devoted to a short historical introduction, a description of the structure of skin, and an account of the fundamental principles of fermentation. After chapters on water and water-softening, follow the various steps in the preparation of the hide for the tan-bath;

soaking, depilation and deliming are described in detail, and then comes a description of the methods of analysing tanning materials.

Of greater interest are the chapters which deal with the preparation of the tanning liquors, including extracts, and the typical method of tanning the various hides. The tannage of sole leather, belting and harness leathers, moroccos, chromes, etc., are well described, and the fat, oil and aldehyde tannages also find a place. In the sections devoted to "finishing," the examples have been well chosen, and the different kinds of leather are each treated separately. The chapters on dyeing and japanning and enamelling are also well written, dyeing being particularly well treated, considering the small space available. The book is brought to a conclusion with a chapter on the analysis of leather.

Taken altogether, *The Manufacture of Leather* should prove a useful text-book on the subject. It is clearly printed, and no pains have been spared in supplementing the text with excellent and up-to-date illustrations and tables.

THE BRAZILIAN YEAR-BOOK, issued under the patronage of the Brazilian Government. Second Issue, 1909. Compiled and edited by J. P. Wileman. Pp. xxiv. + 824. (London: McCorquodale and Co.)

The first issue of this book was reviewed in this *Bulletin* (1908, 6. 332). The most important changes in the new issue are the reduction of the price by one-half, and the provision of an index which adds considerably to its value as a work of reference. The list of public companies is longer, but otherwise there are few modifications or additions. Perhaps in another issue fuller information may be given about the Brazilian railways and the extensions which are in course of construction, or are contemplated. One would have liked, for instance, to have had definite information about the progress of the Madeira-Mamoré railway, which is so important for the development of some of the remoter parts of the country. It is interesting to note the continued success of the measures, analogous to those adopted in India, designed to give the currency a gold basis at the rate of 15*d.* to the milreis and afford stability to the rate of exchange. The enforcement of a 2 per cent. export duty on specie has, however, raised the rate at the present time to 16*d.*

ZAMBESIA: A GENERAL DESCRIPTION OF THE VALLEY OF THE ZAMBESI RIVER, FROM ITS DELTA TO THE RIVER ARSANGWA, WITH ITS HISTORY, AGRICULTURE, FLORA, FAUNA, AND ETHNOGRAPHY. By R. C. Maugham. Pp. xiv. + 408, with maps and illustrations. (London: John Murray, 1910.)

The sub-title adequately indicates the scope of this volume, the author of which is H.B.M. Consul for Portuguese East Africa. Zambesia is a tract of country some 123,000 square miles in area, forming part of Portuguese East Africa. It is divided up between three administrative

bodies, the Zambesia Company controlling 70,000 square miles, the Mozambique Company, 50,000 square miles, and the Luabo Company, the remainder.

Considerable space in the volume is devoted to the economic products, which are in general well dealt with, although a little more care in arrangement would have been of distinct advantage. For instance, chapter four, entitled "The Great Companies," deals nominally with the administrative bodies already mentioned. Incidentally, however, there are introduced, without any sub-headings or other breaks, various accounts of products of their respective territories The two subjects would have been better treated apart, and not in this somewhat confused manner.

The most important industrial enterprise is that of sugar manufacture, and that is carried on under British management and with British employees. The sugar goes to Portugal, receiving preferential treatment equivalent to a bounty of £12 per ton. Coconuts are also doing well, but, on the other hand, cotton cultivation has not been successful, and ground-nuts are not as yet exported to any large extent. Better results are, however, expected in the near future, and it is recognised that the future prosperity of the country is mainly dependent on agriculture. *Landolphia florida* is described as one of the most valuable rubber vines; a view not in agreement with general opinion regarding this plant. A few misprints occur in botanical names, and the "green leaf blight (Malvacearum)" does not afford any definite idea of the pest referred to. A useful feature of the book is the lists of plants, birds, mammals, etc.

Historical and ethnological matters are well dealt with; there is a large number of very good illustrations, and the book as a whole affords a very useful summary of knowledge regarding a part of Africa about which detailed information has not hitherto been accessible in such convenient form.

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SCIENTIFIC AND TECHNICAL DEPARTMENT.

RECENT INVESTIGATIONS.

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Colonial Governments concerned.

SOME WEST AFRICAN TIMBERS.

DURING the last few years a large number of timbers have been submitted to the Imperial Institute from West African Colonies for examination, and in view of the interest at present being shown in the problem of conserving the forest resources of several of these Colonies (this *Bulletin*, 1910, 8. 217, 299), it seems desirable to place on record the results of these investigations. It will be seen from the data given below that a number of these timbers are likely to be suitable for export to this country, and that, although most of the others would not realise high enough prices to be worth exporting, yet they would form excellent materials for local use, and the purposes to which they could be applied are indicated. The working qualities of most of the timbers have been determined for the Imperial Institute by Mr. Herbert Stone, F.L.S., Honorary Expert Referee on

timbers. The valuations quoted have been furnished by well-known commercial experts on timber in Liverpool and London.

GOLD COAST COLONY.

The timbers dealt with were brought to the United Kingdom by Captain C. H. Armitage, D.S.O., Provincial Commissioner in Ashanti, now Chief Commissioner of the Northern Territories, and were exhibited in Liverpool in March 1908. Forty-eight timbers were represented in the collection, and specimens of each of these were forwarded to the Imperial Institute, and the results of their examination are given below.

In the case of the native names supplied by Captain Armitage the first is in the Twi language and the second in Fanti. The botanical names, when given, are quoted from the recent Report on the Forests of the Gold Coast by Mr. H. N. Thompson (see this *Bulletin*, 1910, 8. 217). In certain cases the botanical sources of the timbers have not been identified.

"*Kusia.*" "*Ekusawa.*" *Sarcocephalus esculentus.*—A wood of a beautiful, uniform yellow colour, inclining to orange, with minute specks of red caused by coloured resin in the pores. It was too brittle to be of much use. It was hard, but sawed easily and turned moderately well. It planed hard and badly, the brittleness causing it to chip. Weight, 47½ lb. per cubic foot. The wood took a good polish.

The specimen examined was from a plank 30 inches wide, indicating a tree of fine dimensions. The sapwood was rather darker than the heartwood, and was about 2 inches wide.

"*Chenchen.*" "*Ohonton.*" *Antiaris toxicaria*, var. *africana.*—The specimen was worm-eaten and tainted with decay, so that its qualities could not be properly estimated. The wood was of a uniform yellowish-white colour and of very poor quality. It appeared to be liable to rapid decay, and to be of little value. It worked easily with all tools, in fact far too easily, being soft and light. Weight per cubic foot, 25¼ lb. This appeared to be an all-sapwood tree.

"*Kwatanuro.*" "*Akwatanuro.*" *Lovoa Klaineana.*—This was apparently allied to "*Kwabohori*" (see p. 239). It was a hard, heavy wood, having a certain amount of figure, which made it effective when polished. It was cross-grained and hard to work

but should prove a useful wood. It sawed, turned and planed fairly well and easily, but during the planing pieces ripped out owing to brittleness and cross-grain. The wood finished easily and well. Weight, 55¼ lb. per cubic foot.

This wood was inferior to *Kwabohori* (p. 239), which would displace it for most purposes.

"*Bodwi.*" "*Obodwi.*"—This timber superficially resembled a cross-grained boxwood in colour and to the touch. It sawed hard, planed hard but evenly, and trimmed evenly across the grain. It turned well and took a good finish. Weight, 41 lb. per cubic foot.

This was a useful wood, but liable to shrink and warp considerably. The sapwood in the specimen was about 3 inches wide, and a little lighter in colour than the heartwood.

"*Katawani.*" "*Onwanmah.*"—This specimen was somewhat decayed in the centre, leaving a curious pentagonal pith, still sound, in the middle, and loose enough to be removed by the fingers. It was yellowish-white in colour and of very poor appearance. It sawed and worked very easily with all tools, but being rather stringy "lugged" when planed, and trimmed very badly across the grain. It turned and polished indifferently. Weight, 23¼ lb. per cubic foot. Apparently an all-sapwood tree

"*Kokotsi.*" "*Ankyi.*" *Pynaertia Ealaensis.*—A hard, cross-grained reddish-brown wood. The specimen was badly "shaken," practically falling to pieces. If liable to these deep "shakes" it would be useless for any purpose; otherwise, though not suitable for the European market, it should be useful locally. It sawed hard, and planed hard and badly, owing to the cross-grain, but trimmed cleanly across the end. It was hard to turn, but took a good polish. Weight, 60¼ lb. per cubic foot. The sapwood in the specimen was about 3½ inches wide, and a little darker than the heartwood.

"*Affna Sappa.*" "*Affna.*"—This wood was of a uniform dark yellow colour with a fine grain. In appearance it was not unlike inferior grades of West Indian boxwood. The wood sawed evenly and planed hard but evenly. It was hard to turn, but took a good finish when polished. Weight per cubic foot, 60¼ lb. The tree yielding this timber is apparently an all-

sapwood tree. It is doubtful whether the timber would be of value for export.

"*Bowiwunua.*" "*Bowiwasi.*" *Detarium* sp.—This almost white wood should prove to be generally useful locally as a light wood, but it would not be of sufficient value for export. It worked easily and well with all tools, and took a fairly good polish. Weight per cubic foot, 25½ lb. An all-sapwood tree.

"*Wawa.*" "*Owawa.*" *Triplochiton Johnsonii.*—This was a glossy, soft wood of light yellow colour, and light in weight. If it proves to be strong and durable it should serve for such purposes as those for which spruce is used. The wood worked easily and well with all tools, but took a poor polish after considerable trouble. Weight per cubic foot, 23½ lb.

"*Samantah.*" "*Samantawah.*" *Xylia Evansii.*—A brownish-red wood of unattractive appearance. It was hard to saw, and planed very badly, being cross-grained and ripping out hopelessly. It was hard to turn, but took a good polish which improved its appearance. Weight per cubic foot, 56 lb. The sapwood was about two inches wide, and appeared darker than the heartwood in transverse section, but lighter in the plank.

"*Kuntunkun.*" "*Okitsiwanfu.*"—In structure this wood resembled a mahogany, and its appearance was also that of a third-rate mahogany or cedar. In working, the resemblance was again observed, for the wood behaved with all tools in a similar manner to mahogany. The timber was hardly good enough to take a place with other African furniture woods, unless better specimens can be got. Weight per cubic foot, 28½ lb. The sapwood was 1½ to 2 inches wide.

"*Odupon.*" "*Odupon.*" *Khaya* sp.—A rather handsome red wood, prettily marked in some sections and of nearly uniform colour. This wood might perhaps find a market in Europe as a substitute for mahogany. It sawed easily, planed a little hard, but very evenly and well. The wood turned easily and well and took a good polish. Weight per cubic foot, 48 lb. The sapwood was about 3½ inches wide. The specimen received was badly shaken; if the timber is liable to this defect, its chances of finding a market will be impaired.

"*Dubin.*" "*Odubin.*" *Khaya* sp.—This wood resembled the common qualities of mahogany and cedar, which pass in

England under the name of "baywood," and might be sold as such. The colour was uniform and reddish. The wood sawed easily but planed rather badly, the grain ripping out. Pieces can be trimmed evenly across the ends. The wood turned easily and well and took a fairly good polish. Weight per cubic foot, $32\frac{3}{4}$ lb. The sapwood was about half-an-inch wide. The specimen received was worm-eaten throughout.

"*Dubuma.*" "*Odubima.*"—This wood had a uniform light citron or canary colour. The specimen received was from a small tree about seven inches in diameter, and was all sapwood. It would be interesting to learn whether larger trees produce heartwood. The wood sawed easily, planed hard but fairly well, was easy to turn and took a good polish. Weight per cubic foot, 36 lb.

"*Ekumadua*" (*Eppro*). "*Odantah.*"—A fine-grained, compact wood of uniform red colour and excellent quality. It worked well with all tools and planed quite easily and smoothly. It finished easily and well, but was ineffective when polished. Weight per cubic foot, $50\frac{1}{4}$ lb.

"*Odum.*" "*Odum.*" *Chlorophora excelsa.*—This is a well-known wood, also known as "Iroko." It varies much in colour, the present specimen being golden-brown. The specimen worked fairly easily and well, but was rather cross-grained, and the grain ripped out in certain directions. The grain was open and coarse, and required much filling to finish. When polished the surface was only fair to medium. Weight per cubic foot, $47\frac{1}{4}$ lb.

"*Denya.*" "*Odenya.*" *Piptadenia* sp.—A greenish-yellow wood resembling some species of Artocarpus. It was hard and heavy, and cross-grained to an exceptional degree. It worked exceedingly badly, and would be useful only in large pieces. The wood had a curious and rather unpleasant colour when polished, and a rancid smell when worked. Weight per cubic foot, $65\frac{1}{4}$ lb.

"*Efuobrodidwo.*" "*Cedar.*" *Pseudocedrela utilis.*—This was a good wood of a uniform nut-brown colour, though scarcely ornamental. It is doubtful whether it would be of value for export, but it should be found useful locally. It was very hard to saw, and also, being brittle, hard and uneven to plane. It

turned and polished moderately well. Weight per cubic foot, 45¾ lb. The tree yielding this wood is apparently an all-sapwood tree.

"*Abbusamdua.*" "*Mmonsamdua.*" *Ficus* sp.—This wood had a uniform, greenish-yellow colour and was not ornamental. It was hard to saw and plane, and being cross-grained ripped out badly in planing. It turned and polished fairly well. Weight per cubic foot, 45¼ lb. The sapwood was nearly white and about 1½ inches wide.

"*Opepea.*" "*Opepeh.*" Species of *Mimusops*?—This wood had a poor, dull-brown colour, and was of doubtful value. It was rather hard to saw, and being cross-grained ripped out badly when planed. It was hard to turn, as the grain ripped out, and had a poor appearance when polished. The specimen was badly tainted with decay. Weight per cubic foot, 50¼ lb. The tree is an all-sapwood tree.

"*Dahuma.*" "*Odahuma.*" *Piptadenia africana.*—This was a coarse open-grained wood of a golden-brown colour. The wood worked easily with all tools, but was only of medium quality. It was ineffective when polished, and needed much filling. Weight per cubic foot, 56 lb.

"*Asoma.*" "*Asoma.*" *Ricinodendron africana.*—The specimen being rotten, a fair trial of its working qualities was not possible. It was a poor wood of indifferent appearance. It was easy to saw and also planed easily and well. The wood turned well and took polish moderately well. Weight per cubic foot, 35¼ lb. The tree yielding this timber is an all-sapwood tree.

"*Okuntun.*" "*Okuntani.*"—This was a rather good wood, with a nut-brown colour and reddish-silver grain. It was scarcely good enough for export, but should be useful locally. It sawed very hard and planed hard but firmly. Pieces can be trimmed well at the ends. The wood was hard to turn and took a fairly good polish. Weight per cubic foot, 53 lb. The sapwood was rather lighter than the heartwood, and was about four inches wide.

"*Krubna.*" "*Okumankra.*" Species of *Khaya*?

"*Krubna.*" "*Akwabohori.*" *Khaya anthotheca.*

"*Krubna.*" "*Okumankra.*" Species of *Khaya*?

These were three specimens of Krubna wood, which may be dealt with together. They were mahogany-like woods of varying

quality, the second being the best and the third the worst of the three. The second was approximately equal to Mexican cedar, and the first to baywood; these two may be worth exporting, especially if better samples are to be found in sufficient quantity, but the third was worthless except for local use. It should be remembered that all woods of the mahogany-cedar type possess useful qualities apart from their value as furniture woods. A cheap supply of light, easily-workable mahogany, even if devoid of colour, is much to be desired, the only question being whether the cost of freight can be covered. The three woods worked with all tools as well as mahoganies of equal quality. The sapwood was about two inches wide. The first and third specimens were badly worm-eaten. The weights per cubic foot were respectively 39½ lb.; 30 to 31¾ lb.; and 28 lb.

"*Wawapupuo.*" "*Duamenyi.*" *Sterculia cordifolia.*—This was a neutral-tinted, greyish-brown wood of poor appearance and little value. It sawed very easily, planed and turned fairly, easily and indifferently, and took polish moderately well. Weight per cubic foot, 38¾ lb. The tree yielding this wood is an all-sapwood tree.

"*Okyireh.*" "*Otritreh.*"—This was a dull, whitish-brown wood of uniform colour and poor appearance. It was very soft and light in weight, and was probably useless except for floats for temporary use. It sawed easily, planed easily and unevenly, turned easily and polished moderately well. Weight per cubic foot, 33 lb. The tree yielding this timber is an all-sapwood tree. The specimen was worm-eaten and tainted.

"*Sindru.*" "*Sindru.*"—An inferior wood, whitish-brown and uniformly unattractive in colour. As the specimen was nearly rotten fair trials could not be made, but the timber was of little value. Weight per cubic foot, 20¼ lb. The tree yielding this timber is an all-sapwood tree.

"*Issa.*" "*Issieh.*"—This was a dull-grey wood of poor appearance and doubtful value. It sawed easily, planed moderately easily but unevenly, turned easily and took a medium polish. Weight per cubic foot, 44½ lb. The tree yielding this timber is an all-sapwood tree. The specimen was tainted with decay.

"*Emmiri.*" "*Emmiri.*" *Terminalia* sp.—This was a wood of a uniform yellowish-white colour, which, though a generally,

useful timber, was of doubtful value for export. It sawed easily, planed easily and well, turned easily and took a good polish. Weight per cubic foot, 44½ lb. The tree producing this wood is an all-sapwood tree. The specimen was tainted with decay.

"*Offram.*" "*Offram.*" *Terminalia superba.*—A light-brown wood of no ornamental value but no doubt useful for many purposes locally. It sawed hard although tainted with decay; planed easily and well, turned easily and polished moderately well. Weight per cubic foot, 35½ lb. The sapwood was whitish and about six inches wide.

"*Dantani.*" "*Ofutuki.*"—This was a cross-grained, greyish-brown wood of doubtful value, except perhaps in large pieces for constructional work. The specimen indicated a tree of large dimensions. It sawed rather hard, planed hard and badly, large pieces ripping out during the process on account of the cross-grain. The wood turned moderately well and took a medium polish. Pieces can be trimmed evenly across the ends. The sapwood was about two inches wide and whitish-brown in colour. The specimen was tainted with decay. Weight per cubic foot, 48½ lb.

"*Kernin.*" "*Kernin.*"—This was a yellowish-brown wood with fine white lines. It was of no export value, but may perhaps be useful locally. The wood sawed hard, planed hard but evenly, trimmed evenly across the ends, turned moderately hard and took a good polish. Weight per cubic foot 50¼ lb. The sapwood was 1½ inches wide and nearly white.

"*Deenam.*" "*Odzinam.*"—The specimen of this wood was badly shaken and worm-eaten. The wood resembled a very low quality of mahogany and was brown in colour, striped light and dark. It is no doubt a useful wood locally. It sawed easily, planed exceedingly badly, being stringy, trimmed badly across the ends, turned easily and took a medium finish when polished. Weight per cubic foot, 30¾ lb. The sapwood was about 5 inches wide.

"*Sese.*" "*Osese.*" *Funtumia africana.*—This was a close-grained, uniformly greyish-yellow wood of no value for export but generally useful locally. It sawed easily, planed moderately easily, trimmed badly across the ends, turned easily and took a

good polish. The weight per cubic foot was 38½ lb. The tree producing this wood is an all-sapwood tree.

"*Aheduah.*" "*Aheduah.*" *Cyanothyrsus Ogea.*—This was a coarse, open-grained wood of a glossy light-brown colour. It worked fairly well, but was rather brittle and the grain apt to rip out during planing. It gave trouble in polishing, needing much filling, and the resulting appearance was poor. Two pieces of this timber were examined; one was of rather better quality and worked more easily than the other. The weight per cubic foot was 35½ lb. and 33 lb. respectively.

"*Attawah.*" "*Ekuamah.*" *Pentaclethra macrophylla.*—A coarse, open-grained, hard and heavy wood of uniform red colour. The pores were so coarse that in a vertical section of the wood the septs were visible to the naked eye. The timber was hard to saw, but planed easily and well. It took a good polish, though requiring much filling, but the result was ineffective. Weight per cubic foot, 62 lb.

"*Wansanwah*" (*Appapayi*). "*Appapayi.*" *Khaya grandis.*—This was a generally useful wood of uniform nearly white colour but of no value for export. The wood sawed easily, planed easily and well, trimmed badly across the ends, turned easily and took a fairly good polish. Weight per cubic foot, 32¼ lb. An all-sapwood tree.

"*Onyina.*" "*Onyina.*" *Eriodendron anfractuosum.*—This was a dull, uniformly greyish-brown wood of indifferent appearance. The specimen was more or less decayed. The wood sawed easily, planed moderately easily and fairly well, turned easily and well and took a very fair polish. Weight per cubic foot, 18¾ lb. An all-sapwood tree.

"*Supuwa.*" "*Osupuwa.*" *Sarcocephalus* sp.?—A wood of uniform brownish colour recalling satin walnut. It was of no export value, but should be useful locally. The wood sawed very easily, planed moderately easily and evenly, trimmed badly across the ends, turned easily and well and took a fairly good polish. Weight per cubic foot, 34 to 36 lb. The specimen was somewhat tainted with decay. The tree yielding this timber is an all-sapwood tree.

"*Kwabohori.*" "*Akwdnfanuro.*" *Khaya anthotheca* or *Lovoa Klaineana.*—This wood had a beautiful wavy figure and was

fine-grained and compact. The pores though small were very numerous and the surface appeared grainy in consequence. The wood was pink in colour but rather pale; if it were of a richer colour it would make a valuable furniture wood. However, it was very effective when polished, being glossy and fiery. The wood worked easily with all tools, but was inclined to be troublesome in planing, as it ripped up occasionally, which indicates brittleness. It polished easily and well. Weight per cubic foot, 43½ lb.

"*Yaryah.*" "*Yaryah.*" *Mitragyne macrophylla.*—This was a cross-grained, light-brown wood of uniform colour, which may be useful locally, but not for export. It sawed hard, planed hard but unevenly, turned moderately hard and took a medium polish. It trimmed badly across the ends. Weight per cubic foot, 54 lb. The tree from which this wood is obtained is an all-sapwood tree.

"*Eseah.*" "*Eseah.*" *Combretum* sp.—A brownish-red wood of uniform colour with a cheese-like smell. It would possibly be of value for export as a third-rate mahogany substitute. No doubt it will be useful locally. The wood sawed very hard, and planed very hard but fairly evenly, though the grain ripped out here and there. It turned moderately well and took a fairly good polish. Weight per cubic foot, 33¼ lb. The sapwood was about three inches wide, white and well-defined from the heart-wood. The specimen was somewhat shaken.

"*Takwadua.*" "*Takwadua.*" *Blighia sapida.*—This was a streaky, greyish-brown wood, not ornamental and of no value for export. It sawed hard, planed very hard and unevenly, trimmed evenly across the ends, was hard to turn and took a good polish. Weight per cubic foot, 54 lb. The sapwood was about 1½ inches wide.

"*Abertsin.*" "*Abertsin.*"—A palm wood of fair quality, hard and firm towards the exterior and not too soft within to prevent its use in the whole trunk or in large pieces. It sawed very hard and made a good plank. The wood was not suitable for other tests as the hard strands ripped out. Weight per cubic foot, 51 lb.

"*Arkyi.*" "*Arkyi.*"—This was a pale-brown wood of poor appearance. Being brittle it was of no value either for export

or for local use, except perhaps in large pieces. The wood sawed hard, planed moderately hard but unevenly, trimmed evenly across the ends, turned moderately well and took a medium polish. Weight per cubic foot, 34¼ lb. The specimen was worm-eaten. The sapwood was rather darker than the heartwood.

"*Kakoo.*" *Lophira procera.*—This wood appeared to be very similar to that of *Lophira alata*, which is frequently seen on the Liverpool market and is sold as "African oak." The latter name is however misleading, as it is applied also to *Oldfieldia africana.* The wood has never been in great demand, its chief merit being its very rich colour, which is red, streaked with chalky white lines. It is coarse-grained, hard, heavy, and hard to work, but is a good furniture and turner's wood. The grain is open and coarse and takes much filling during polishing, but it is very effective. Weight per cubic foot, 65½ lb.

Conclusions.

Few of these timbers can be recommended for export, but there are a considerable number which should prove useful in the Gold Coast.

The woods most generally useful are as a rule those whose weight lies between 30 lb. and 50 lb. per cubic foot. Woods weighing less than 30 lb. per cubic foot, except coniferous timbers, are of poor quality and do not even make good fuel. On the other hand, those which weigh above 50 lb. per cubic foot, unless ornamental and suitable for turnery and furniture or not too hard for paving, are usually too heavy and difficult to work. Consequently their use is restricted to purposes where they can be employed in large pieces.

The most promising timbers for export are the following:—

Kwatanuro. Akwatanuro. *Lovoa Klaineana.*
Odupon. *Khaya* sp.
Dubin. Odubin. *Khaya* sp.
Odum. *Chlorophora excelsa.*
Krubna. Okumankra. *Khaya* sp.?
Krubna. Akwabohori. *Khaya anthotheca.*
Kwabohori. Akwantanuro. *Khaya anthotheca* or *Lovoa Klaineana.*
Eseah. *Combretum* sp.
Kakoo. *Lophira procera.*

NORTHERN NIGERIA.

MAHOGANY.

These specimens of mahogany were received in January and February 1908. They were forwarded to this country by the Government of Northern Nigeria in order to ascertain the commercial value of the timber and the possibility of developing an export trade in it.

The material supplied consisted of two large logs, 8 feet by 18 inches by 8 inches, and two smaller logs, 4 feet by 22 inches by 8 inches. A chair leg, apparently turned from the same wood, was received in the following June.

Samples of the mahogany were submitted to timber experts, who also inspected the logs. They reported that the wood was of satisfactory quality, but that the pieces appeared to have been cut from small and, in some cases, very defective logs. In their opinion it would be impossible to obtain remunerative prices for such small wood, but if it is possible to ship well-squared, straight logs, 14 feet and upwards in length and 24 inches or more square, with a good proportion of logs 30 inches square, they have no doubt that a satisfactory market could be found for the timber. The logs should be hewn square along the sides and sawn at the ends.

One of the pieces sent had a forked end with two hearts. At present there is no demand for such wood, and it is advisable to cut the logs free from these forked or curled ends.

The wood from which the chair leg had been made was of about the usual quality of mahogany from West Africa, but would not be considered very suitable for turnery work in the United Kingdom.

The value of this mahogany depends upon the size and condition of the logs. At the present time prices would range on an average from about *2d.* to $4\frac{1}{2}$*d.* per foot super, brokers' sale measure, which makes allowances amounting altogether to about 30 per cent. from the actual measurement.

In June 1908 three further samples of timber were received from Northern Nigeria, of which Nos. 1 and 2 were mahogany of the usual West African type.

The samples consisted of roughly-trimmed pieces measuring about 22 inches × 9 inches × $2\frac{1}{2}$ inches.

The timbers were submitted to experts for the determination of their working qualities and commercial value, and the results of the examination are as follows.

Nos. 1 *and* 2.—These specimens were very similar to each other, and were good examples of the class of Meliaceous timbers commercially known as "African Mahogany."

The wood had the typical pink tone, and black deposit in its pores, which distinguish this class of timber. No. 2 was straighter in the grain than No. 1, showed less figure and was not quite so heavy, weighing 49 lb. per cubic foot against 51 lb. per cubic foot in the case of No. 1.

In hardness the wood equalled Spanish mahogany, and it cleaved and sawed much in the same manner as the coarser varieties of that timber. The colour and figure were good, the latter resembling the shaded figure seen in Spanish mahogany and some kinds of satinwood. The wood was cross-grained, with large pores and fine rays; it picked up considerably in planing, but a good surface could be obtained by the use of a steel scraper. Care was required in polishing, owing to the open character of the grain, but a very pleasing appearance can be produced with ordinary French polish. For a coarse-grained wood this material turned well in the lathe.

The quality of this timber appeared to be at least as good as the mahogany regularly shipped from Southern Nigeria, and it is likely that large quantities of it could be sold in the London market. For export the logs should be hewn square, and sawn at the ends quite straight and as free from splits, knots and other defects as possible; the larger the logs, the higher will be their value, provided they are sound. They should be at least 14 feet long, and none should be less than 20 inches square. The bulk of them should be from 24 to 36 inches square. The price obtainable would depend entirely on the condition and growth of the logs, and would probably range from *2d.* to *4½d.* per foot super (brokers' sale measure, which on the average is about 30 per cent. less than the actual measurement).

ZOOKA WOOD.

The botanical origin of this timber is unknown. The piece was not well selected, having been cut from the bole at a point

where there were several branchings, and at these points there were faults. The wood was very hard and compact with a sharply-defined boundary between heart and sapwood as in ebony, lignum vitæ and Cocus wood; it resembled the last named in general appearance, but was less lined in its longitudinal figure. The rays were extremely fine, and the pores, which are only visible with a lens, contained no apparent deposit. The heartwood was a dull brown tinged with purple, and the sapwood a light olive-brown. The sapwood was very hard and fine-grained, taking stain much in the same way as British holly.

Both heart and sapwood were very tough, and when cleft, tore apart in long elastic fibres. The wood was similar to Cocus wood in its behaviour when worked; it required care, but when properly treated gave a hard marble-like surface. It took polish well, but under this process the colour of the heartwood deepened and became nearly black. It was an excellent turning wood, and should be useful for small turnery where keen edges are required and where a brittle wood might fail.

There appeared to be no free colour in the wood, spirit having no effect as a solvent.

This timber was very heavy, weighing 66 lb. per cubic foot, and if water transit is attempted the logs must be rafted with some light, buoyant wood.

There is no special demand for timber of this class, unless it can supplant other well-known kinds by being obtainable at a lower price. This particular wood might be a good substitute for Cocus wood, the value of which ranges from £3 to £8 per ton, shipped in the round with the bark on. In such consignments, the diameter of the heartwood should not be less than 4 inches at the small end.

GAMBIA.

Specimens of "rosewood" and "mahogany" from this Colony were forwarded to the Imperial Institute at the request of the Superintendent of Agriculture for the West African Colonies and Protectorates in March, 1907.

"ROSEWOOD." (*Dalbergia* sp.)

This specimen was reddish yellow with darker lines and red pores which gave a character to the wood. It was very solid and compact, resembling the true rosewoods in all physical characters except colour. The timber would not pass as a rosewood on the English market, and should not be offered as such, but it would make a good furniture wood, especially if darker samples can be obtained. The wood had an agreeable odour and was hard and very heavy, the weight per cubic foot being 45½ lb. It sawed very easily but was difficult to plane owing to its brittleness, but the planing left a smooth and bright surface; it turned and polished very well.

MAHOGANY.

This timber resembled a specimen of the timber of *Khaya senegalensis*, recently received from Southern Nigeria. It may be regarded as an inferior baywood.

The wood was light in colour and of poor figure, the surface when planed being bright and woolly in alternate bands. It was moderately hard and very cross-grained, sawed easily but was troublesome and hard to plane. It turned easily and polished well. The weight per cubic foot was 41½ lb.

It is not probable that this timber would be of sufficient value for export, but as it is easy to cut up and possesses many of the good qualities of mahogany it should be extremely useful locally.

WATTLE BARKS FROM THE TRANSVAAL AND THE EAST AFRICA PROTECTORATE.

In a general article on the "Production and Utilisation of Wattle Bark," published previously in this *Bulletin* (1908, 6. 157), attention was directed to the fact that wattles are being planted on a small scale in the Transvaal, East Africa Protectorate and elsewhere in the British Empire, but that the principal centres of production were Natal and the Australian Colonies, which together produced practically all the wattle bark marketed. In Natal wattles have been cultivated mainly for

the production of bark, but it seems likely that in the future these trees may be grown extensively for the sake of their timber, in countries where fuel is scarce, since they grow with great rapidity and yield hard wood, of good fuel value. At present, however, wattles are mainly of interest on account of the bark they yield, which is rich in tannic acid and is a valuable tanning material. The Imperial Institute has received recently a series of samples of wattle barks grown in the Transvaal and in the East Africa Protectorate, and as these have proved on examination to be of good quality and to present certain features of interest, the results are now published.

SAMPLES FROM THE TRANSVAAL.

Description.

No. "A. 1. Taken from a tree planted in 1895."

Large quills of bark, $\frac{3}{16}$ inch thick, greenish-grey and fairly smooth externally. The bark showed a fairly compact fracture of a characteristic, light pink colour. It produced a rather dull-coloured leather having the usual characteristics of wattle-tanned leather.

No. "A. 2. From a tree planted in 1891."

Large quills of thick, heavy bark. The outer bark was very dark in colour, and rough, possibly owing to "weathering." The inner surface was of dull walnut colour. The bark produced a rather dark and dull-coloured leather, but otherwise of the usual "wattle" type.

No. "A. 3. From a tree planted in 1901."

A mixture of small and large quills of bark, $\frac{1}{8}$ inch thick. The outer surface was dark grey and "weathered"; the inner surface of rather dark walnut colour. The bark showed a compact fracture of pink colour. It produced a good leather of light colour and fair texture.

No. "A. 4. From a tree planted in 1883."

A few pieces about 1 foot in length of old, heavy bark, nearly $\frac{1}{2}$ inch thick in places. The exterior bark was nearly black, very rough, about $\frac{1}{4}$ inch thick and easily detachable in scales. The inner surface was of reddish colour. The bark had a fibrous fracture. It produced a dark-reddish coloured leather, which was very harsh and brittle.

No. "B. 1. Black wattle bark from a tree 8 years old."

Small chips of thin bark, with smooth grey exterior which was not detachable. The inner surface was pinkish and the bark light-coloured throughout. It produced a fairly light-coloured but rather dull, harsh leather, showing a tendency to be brittle.

No. "B. 2. Black wattle bark from 10-year-old trees."

Small chips of thin bark, somewhat dark externally and pinkish-brown on the inner surface. The exterior layer was rough and easily detached. The bark showed a compact, but slightly fibrous fracture. It produced a fairly light-coloured leather, of dull appearance and rather harsh and brittle.

No. "B. 3. From a tree 12 years old."

Small chips of thin branch bark, smooth and light silver-grey externally. The inner surface was of dark walnut colour. The bark showed a compact fracture. It produced a moderately light-coloured, typical "wattle" leather, of good, rather soft texture and free from harshness.

No. "B. 4. From a tree 9 years old."

Small chips of thin branch bark, smooth and silver-grey externally, and of pale walnut colour on the inner surface. The exterior layer was not detachable. The bark showed a fibrous fracture. It produced a light-coloured leather of good texture and appearance.

No. "C. 1. From a tree 3 years old."

Small chips and chopped quills of thin reddish branch bark, rough, and very dark grey externally, and reddish-brown on the inner surface. The bark showed a compact fracture. It gave a light pink leather of soft texture.

No. "C. 2. From a tree 6 years old."

Cuttings, 1 to 1½ inch long, of narrow quills of very thin bark, greenish in colour and spotted with red. The inner surface was fibrous and of very light walnut colour. The bark produced a very light-coloured leather, which was soft and rather spongy.

Results of Examination.

On analysis these barks gave the results recorded in the following table:—

Number of sample.	Botanical source.	Age of tree (years).	Percentage of Moisture.	Percentage of tannin.	Percentage of non-tannin extractive matter.	Percentage of ash.	Character of leather.
A. 1.	*Acacia decurrens*, var. *mollissima*.	14	13·0	42·1	8·7	1·6	Dull colour, good texture.
A. 2.	ditto.	18	12·2	26·7	6·3	1·5	Rather dark, good texture.
A. 3.	ditto.	8	10·2	41·5	12·1	1·5	Light colour, good texture.
A. 4.	ditto.	26	11·7	24·8	5·4	1·7	Dark reddish and harsh.
B. 1.	ditto.	8	11·6	38·6	10·8	2·4	Rather dull and somewhat harsh.
B. 2.	ditto.	10	12·4	39·2	9·4	1·6	Light, but dull in colour, and rather harsh.
B. 3.	ditto.	12	11·1	37·5	13·2	1·9	Good colour, rather soft.
B. 4.	ditto.	9	11·2	36·7	14·7	1·9	Good colour and texture.
C. 1.	ditto. (?)	3	9·7	27·9	12·7	2·1	Good colour, rather soft.
C. 2.	*A. decurrens*, var. *normalis*.	6	9·1	24·4	11·6	3·5	Pale colour, soft and rather spongy.

All these barks represent tanning materials which would be readily saleable in this country, but with the possible exception of Nos. A3, B1, B4, C1 and C2, they probably do not represent materials which could be regularly marketed in quantity, since unless the bark is regarded merely as a secondary consideration it would generally be unremunerative to maintain wattle plantations for more than about seven years before harvesting the bark. It seems clear, however, from the results obtained with Nos. A3, B1, and B4, that wattle bark of normal richness could be produced in the Transvaal in plantations maintained for the usual length of time, viz. from five to seven years.

The samples are of interest as indicating that the percentage of tannin does not increase much after the seventh or eighth year; thus, the second richest bark is No. A3, obtained from an eight-year-old tree. The remarkable diminution shown by A4, from a tree twenty-six years old, is probably due to the damaged state of the bark, which showed signs of having been partially burnt, probably in a plantation fire.

Commercial Valuation.

Samples of all ten barks were submitted to commercial experts for valuation, with copies of the analytical results

obtained in each case. The classifications and valuations of the barks thus obtained were as follows:—

No. of Sample.	*Commercial Description.*	*Estimated Value per ton.* £ s. d.
A1.	"Sound, clean, bright bark"	9 0 0
A2.	"Well-grown, stout bark with old, seasoned and burnt scale"	6 10 0
A3.	"Well grown, rather rough, hard mixed"	7 10 0
A4.	"Old, burnt bark of doubtful colour"	5 0 0
B1 & B4.	"Small and bough bark, resembling Natal ordinary"	7 5 0
B2 & B3.	"Partly burnt and wasteful"	6 15 0 to 7 0 0
C1.	"Somewhat resembles Cape bark"	5 10 0
C2.	"Short thin twig bark"	5 10 0

It will be noted that the valuations quoted do not depend entirely on the amount of tannin present in the bark, thus A1, which contains little more tannin than A3, is quoted at a higher price. This is mainly due to the fact that A3 was a mixed sample of rather thin bark. Tanners prefer, as a rule, stout, well-developed bark, since experience with Natal and Australian barks has shown that such materials yield leather of good colour and firm texture, whilst thin bark, almost as rich in tannin, but from branches or stem of young trees, gives leather of good colour and texture, but usually rather softer than that from bark of the kind already described.

With the exception of Nos. A4, C1, and C2, which are all poor in tannin, the values quoted compare very favourably with those obtained for Natal and Australian wattle barks.

The brokers who valued the present samples on the basis of the analytical results given above, stated that they would be glad to take charge of and sell consignments of wattle bark of similar quality.

SAMPLES FROM THE EAST AFRICA PROTECTORATE.

Description.

No. 1. "Age 5 years."

Large quills, and some small strips of reddish-brown bark

about $\frac{1}{8}$ to $\frac{3}{16}$ inch thick, with dark reddish-brown inner surface. The fracture was fibrous and light in colour. The bark produced a light-pinkish leather of good texture.

No. 2. "Age, 4½ years."

Long quills of smooth dark-coloured bark, varying from $\frac{1}{8}$ to $\frac{3}{8}$ inch thick. The thicker pieces were fibrous and had a reddish inner surface, whilst the thinner pieces were of dull walnut colour on the inner surface. In both cases the fracture was light in colour. The bark produced a light-pinkish leather of good stiff texture.

No. 3. "Age, 3½ years."

Quills of bark, larger and thicker than the two preceding samples, and rough externally. The inner surface was dark orange-brown. The fracture was light in colour. The bark produced a light-coloured leather, very similar to that given by sample No. 2.

No. 4. "Age, 3½ years."

A mixture of thin flat strips and large thick quills of bark. The outer surface was dark green and striated with orange-brown marks; the inner surface smooth and dark brown. The fracture was light-coloured and fibrous. The bark gave a firm light-coloured leather, of stiff texture but free from harshness.

No. 5. "Age, about 6½ years."

Rather narrow quills of dark brown, somewhat tough bark about $\frac{1}{8}$ inch thick. The inner surface was light reddish-brown. The fracture was fibrous and of fawn colour. The bark gave a light-coloured leather, similar in character to that furnished by No. 4.

Results of Examination.

On analysis these barks gave the following results:—

Number of sample.	Age of tree (years).	Percentage of moisture.	Percentage of tannin.	Percentage of non-tannin extractive matter.	Percentage of ash.	Nature of leather produced.
1	5	12·9	38·4	12·2	2·4	Good colour and texture.
2	4½	9·0	43·6	10·4	2·7	Good colour and stiff texture
3	3½	10·6	39·6	11·2	3·2	,, ,, ,, ,,
4	3½	9·9	40·3	10·3	3·0	,, ,, ,, ,,
5	6½	11·9	35·8	12·2	1·9	,, ,, ,, ,,

These barks are all rich in tannin and represent materials which would be readily saleable in the United Kingdom. As a general rule it is necessary to maintain wattle plantations for at least five years before they yield bark of marketable quality, and in this connection, samples 2, 3 and 4, which are the richest of the series, though derived from trees only 3½ to 4½ years old, are of special interest. The leathers produced by these barks are all of good quality, being of pleasant light colour, of good texture, and free from harshness.

Samples of the five barks were submitted, with copies of the analytical results for each bark as recorded above, to commercial experts for valuation, and the following valuations were thus obtained:—

No. of Sample.	*Commercial Description.*	*Estimated Value per ton.* £	s.	d.
1, 2.	"Well-grown, mostly of good substance, clean but rather dark inside"	8	0	0
3.	"Stout, better colour than Nos. 1 and 2"	8	5	0
4.	"Equal to best Natal"	8	10	0
		to		
		8	15	0
5.	"Not quite so stout or well-prepared as No. 4"	8	10	0

The brokers, who valued these samples on the basis of the analytical results given above, stated that they would be glad to receive consignments of similar quality for sale. In this connection it should be noted that in preparing wattle bark for export, great care should be taken that the bark is stored under cover and thoroughly dried before shipment, as otherwise loss of tannin and darkening of colour are likely to occur. Wattle bark is usually sold according to brand, and it is therefore advisable that each plantation should endeavour to market its bark in uniform condition from year to year and thus establish a recognised standard for its produce.

The following further sample of wattle bark was received from East Africa in April of this year. It was described as bark of Black Wattle (*Acacia decurrens*, var. *mollissima*).

The sample was stated to have been obtained from trees ten years old, growing at an altitude of 6,800 feet in deep red soil.

It consisted of long quills of bark, ⅛ inch thick, and fairly smooth. The outer surface was reddish-black and the inner surface dark dirty red; the fracture was pale reddish-brown.

The bark gave the following results on analysis:—

	Per cent.
Moisture	11·4
Ash	1·7
Tannin	39·7
Non-tannin extractive matter	11·8

It produced a light-pinkish leather of good texture and appearance.

Thick well-grown, well-prepared wattle bark of the same quality as this sample would be worth about £8 15*s.* to £9 per ton in the United Kingdom under present conditions (July 1910).

This sample was stated to be derived from trees ten years old, but it will be noted that the percentage of tannin present is less than in some of the barks obtained from much younger trees in the East Africa Protectorate, and referred to above.

EDIBLE BEANS FROM THE EAST AFRICA PROTECTORATE.

DURING the last year or two a great deal of attention has been given by the Department of Agriculture in East Africa to the cultivation of beans for export, and a large number of varieties are being tried experimentally in order to ascertain which kinds do best and can be recommended to planters for cultivation. A series of samples of the beans obtained in these experiments has been sent to the Imperial Institute recently for examination and valuation. The results given below show that these beans are of excellent quality, and consist of varieties likely to meet with a ready sale in the United Kingdom if they can be produced in quantity.

In examining these samples, each was submitted to the usual scheme of analysis, and in addition each variety was tested for the production of prussic acid and for the presence of alkaloids. In no case was any trace of these deleterious constituents found,

so that all these varieties of beans may be safely recommended for use as food, or, in the case of the poorer, coloured beans, as feeding-stuffs for animals.

The valuations quoted were supplied by commercial experts in London, based on the analytical results obtained at the Imperial Institute.

RESULTS OF EXAMINATION.

No. 0. *Variety* "**Soroko.**" Small kidney-shaped but somewhat angular beans, about ¼ inch long, and varying in colour from fawn to purplish-brown; a few dirty cream-coloured beans were present.

On analysis the following results were obtained:—

	Per cent.		*Per cent.*
Moisture	12·36	Fibre	4·54
Crude proteins	25·37	Ash	2·98
Fat	1·05	Nutrient ratio *	1 : 2·21
Starch, etc.	53·70	Food units †	119·7

Estimated value as a feeding stuff:—£6 2*s.* 6*d.* to £6 5*s.* per ton, c.i.f. United Kingdom ports (February 1910).

No. 2. *Variety* "**Black Posho.**" Black kidney-shaped beans about $\frac{7}{16}$ inch in length, with small white hilum.

On analysis the following results were obtained:—

	Per cent.		*Per cent.*
Moisture	12·44	Fibre	3·69
Crude proteins	22·56	Ash	3·28
Fat	1·11	Nutrient ratio	1 : 2·55
Starch, etc.	54·87	Food units	114·1

Estimated value as a feeding stuff:—£6 2*s.* 6*d.* to £6 5*s.* per ton, c.i.f. United Kingdom ports (February 1910).

No. 4. *Variety* "**Ngena.**" Small rounded seeds about ⅛ inch in diameter, of dull grass-green colour, with white oval hilum. The sample was slightly attacked by weevils.

* The ratio between the percentage of crude proteins and the sum of the percentages of starch and fat, the latter being first converted into its starch equivalent.

† The total obtained by adding the percentage of starch to 2·5 times the sum of the percentages of fat and crude proteins.

These beans had the following composition:—

	Per cent.		Per cent.
Moisture	14·86	Fibre	3·80
Crude proteins	23·92	Ash	2·87
Fat	0·86	Nutrient ratio	1 : 2·33
Starch, etc.	53·69	Food units	115·6

Estimated value as a feeding stuff:—about £5 10*s.* per ton, c.i.f. United Kingdom ports (February 1910).

A. *Variety* "**Black Chiroko.**" Small hard beans, almost cylindrical in shape, and brownish-black in colour, with conspicuous white hilum.

	Per cent.		Per cent.
Moisture	8·38	Fibre	3·16
Crude proteins	29·28	Ash	3·46
Fat	1·23	Nutrient ratio	1 : 1·9
Starch, etc.	54·49	Food units	130·76

The beans were submitted to commercial experts who valued them for feeding purposes at £5 per ton in London (June 1910). They added, however, that this price might not be realised at first, since, although analysis shows these beans to be of very good quality, their colour would be unfavourable to their sale until they became thoroughly known on the market.

No. 19. *Variety* "**Native Food.**" The sample consisted of roundish beans, with a loose, shrivelled, yellowish-white outer husk which was readily detachable. The kernel was dark greenish black, and rather soft. Many of the beans were almost black in colour, and the sample contained a quantity of broken husks.

	Per cent.		Per cent.
Moisture	17·88	Fibre	1·34
Crude proteins	19·25	Ash	5·32
Fat	0·49	Nutrient ratio	1 : 2·9
Starch, etc.	55·72	Food units	105·06

These beans were submitted to commercial experts, who reported that they would probably be unsaleable in London, even for feeding purposes, and that it was therefore not possible to quote a value for them.

No. 1. *Variety* "**White Njahe.**" Oval beans nearly black with long raised white hilum, resembling *Dolichos lablab* beans. The sample was somewhat weevilled.

The beans had the following composition:—

	Per cent.		Per cent.
Moisture	12·50	Fibre	5·96
Crude proteins	20·50	Ash	3·04
Fat	1·29	Nutrient ratio	1 : 2·92
Starch, etc.	56·71	Food units	111·2

Estimated value as a feeding stuff:—£6 2*s.* 6*d.* to £6 5*s.* per ton, c.i.f. United Kingdom ports (February 1910).

No. 17. *Variety* "**Red Njahe.**" Beans resembling sample No. 1 "White Njahe," but of reddish-brown colour instead of black. The sample was slightly weevilled.

	Per cent.		Per cent.
Moisture	12·30	Fibre	6·99
Crude proteins	21·06	Ash	3·04
Fat	1·05	Nutrient ratio	1 : 2·75
Starch, etc.	55·56	Food units	110·8

Estimated value as a feeding stuff:—£6 2*s.* 6*d.* to £6 5*s.* per ton, c.i.f. United Kingdom ports (February 1910).

No. 18. *Variety* "**Red Njahe.**" Oval, reddish-brown beans with long, raised white hilum. A few of the beans were weevilled. These beans resemble the "White Njahe" and "Red Njahe" varieties described above.

	Per cent.		Per cent.
Moisture	10·48	Fibre	6·50
Crude proteins	21·70	Ash	3·00
Fat	1·12	Nutrient ratio	1 : 2·75
Starch, etc.	57·20	Food units	114·25

Estimated value as a feeding stuff:—£5 per ton in London (June 1910).*

No. 11. *Variety* "**Kunde Black.**" Small dark purple beans of

* It will be noticed that the valuations obtained in June 1910 are uniformly lower than those obtained in February 1910 for beans of similar quality. This is due to a general fall in the price of leguminous feeding stuffs between the dates of the two valuations.

rather variable shape, with small oval hilum; average length about ¼ inch. The sample was slightly weevilled.

	Per cent.		Per cent.
Moisture	11·33	Fibre	4·17
Crude proteins	24·00	Ash	3·20
Fat	1·13	Nutrient ratio	1 : 2·46
Starch, etc.	56·17	Food units	119·0

Estimated value as a feeding stuff:—£6 2*s.* 6*d.* to £6 5*s.* per ton, c.i.f. United Kingdom ports (February 1910).

B. *Variety* "**Kunde Red.**" Small beans of irregular shape, varying in colour from fawn to brown. Many of the beans were weevilled.

	Per cent.		Per cent.
Moisture	7·79	Fibre	3·86
Crude proteins	24·44	Ash	3·32
Fat	1·85	Nutrient ratio	1 : 2·5
Starch, etc.	58·74	Food units	124·46

Estimated value as a feeding stuff:—£5 5*s.* per ton in London (June 1910).

No. 3. *Variety* "**Maragwe.**" Kidney-shaped beans about ⅜ inch long, with small hilum; grey or reddish-fawn in colour, striped and splashed with black.

An analysis gave the following results:—

	Per cent.		Per cent.
Moisture	12·88	Fibre	3·15
Crude proteins	21·30	Ash	3·62
Fat	0·96	Nutrient ratio	1 : 2·84
Starch, etc.	58·19	Food units	113·8

The commercial experts reported that these beans are suitable for use as human food, but would be difficult to sell in the United Kingdom. The best market would probably be South Africa, where they should be worth about £9 per ton (February 1910).

No. 12. *Variety* "**Maragwe.**" Medium-sized oval or rounded beans, averaging 7/16 inch in length, and of even light stone-grey colour; a few white beans were also present. The hilum was white and surrounded by a dark ring.

	Per cent.		Per cent.
Moisture	11·24	Fibre	3·36
Crude proteins	21·87	Ash	3·59
Fat	1·10	Nutrient ratio	1 : 2·81
Starch, etc.	58·84	Food units	116·30

Commercial experts reported that these beans might be used for human food. They stated, however, that they would be more likely to sell well on the Continent than in the United Kingdom for this purpose (February 1910).

No. 20. *Variety* "**Maragwe Grey.**" Medium-sized oval beans, of greyish stone colour with small white hilum edged with black. Most of the beans were in good condition, but a few were shrivelled.

	Per cent.		Per cent.
Moisture	10·90	Fibre	4·08
Crude proteins	21·61	Ash	3·28
Fat	1·24	Nutrient ratio	1 : 2·85
Starch, etc.	58·89	Food units	116·00

These beans appear to be practically identical with the Maragwe beans, variety No. 12" (see above). They were submitted to commerical experts, who stated that they should find a ready market in Europe for human consumption, and that their value in London would be £6 per ton (June 1910).

F. *Variety* "**Dwarf Marvel.**" Bright, black kidney-shaped beans with inconspicuous white hilum.

	Per cent.		Per cent.
Moisture	10·56	Fibre	4·12
Crude proteins	31·94	Ash	2·82
Fat	1·06	Nutrient ratio	1 : 1·60
Starch, etc.	49·50	Food units	132·00

These beans were submitted to commercial experts, who reported that it should be easy to find a market for them as human food, and that their value in London would be about £9 a ton (June, 1910).

No. 9. *Variety* "**White Posho.**" Medium-sized white beans about ⅜ inch long, with small hilum. The beans were lightly covered with brown dust; the surface was occasionally crinkled.

	Per cent.		Per cent.
Moisture	12·89	Fibre	2·94
Crude proteins	21·37	Ash	3·13
Fat	1·55	Nutrient ratio	1 : 2·90
Starch, etc.	58·12	Food units	115·30

These beans were valued by commercial experts at about £9 to £9 10*s.* per ton, c.i.f. United Kingdom ports (February 1910).

No. 5. *Variety* "**Canadian Wonder.**" Kidney-shaped beans, nearly ¾ inch in length, of deep rich purple brown colour, with small oval hilum.

On analysis the following results were obtained :—

	Per cent.		Per cent.
Moisture	13·52	Fibre	2·96
Crude proteins	21·00	Ash	3·19
Fat	0·95	Nutrient ratio	1 : 2·89
Starch, etc.	58·38	Food units	113·20

The commercial experts reported that the demand in the United Kingdom for beans of this type is small, but that the probable value in London would be about £9 per ton (February 1910).

No. 6. *Variety* "**French Cocos.**" Small oval beans of cream colour, lightly covered with brown dust. The surface was slightly wrinkled, owing to the drying of the beans.

An analysis proved that the beans had the following composition :—

	Per cent.		Per cent.
Moisture	13·35	Fibre	3·04
Crude proteins	25·93	Ash	3·88
Fat	1·50	Nutrient ratio	1 : 2·16
Starch, etc.	52·30	Food units	121·00

The beans were described by commercial experts as rather small for "French Cocos" beans. The sample was old and broken, and for that reason would be unsuitable for human consumption. If shipped in good condition the probable value of these beans would be from £9 10*s.* to £10 per ton, c.i.f. United Kingdom ports (February 1910).

No. 7. *Variety* "**Rose Cocos.**" Large plump beans about ⅝ inch

long, of pale fawn colour, striped and splashed with purple maroon The hilum was oval and surrounded by a light-brown ring.

	Per cent.		Per cent.
Moisture . . .	12·23	Fibre	3·34
Crude proteins . .	26·31	Ash	3·14
Fat	1·12	Nutrient ratio . .	1 : 2·15
Starch, etc. . . .	53·86	Food units . .	122·40

The commercial experts reported that these beans are of good quality and likely to be readily saleable in the United Kingdom at from £9 to £9 5*s.* per ton, c.i.f. (February 1910), but it is possible that better prices would be realised in South Africa, where the demand for similar beans is good.

No. 8. *Variety* "**White Capucin.**" Pale oblong beans with almost square ends and possessing a distinct green colour. The beans were covered with brownish dust.

	Per cent.		Per cent.
Moisture	13·61	Fibre	3·21
Crude proteins . .	24·43	Ash	3·48
Fat	1·31	Nutrient ratio .	1 : 2·34
Starch etc. . . .	53·96	Food units . .	118·3

The commercial experts reported that these beans are of very good quality, and should be readily saleable at about £12 per ton, c.i.f. United Kingdom ports (February 1910).

G. *Variety* "**Yellow Haricot.**" Dull orange-yellow, kidney-shaped beans with small white hilum. A few broken beans were present in the sample.

	Per cent.		Per cent.
Moisture	10·18	Fibre	2·56
Crude proteins . .	26·16	Ash	2·42
Fat	1·38	Nutrient ratio .	1 : 2·3
Starch etc. . . .	57·30	Food units . .	126

Commercial experts reported that these beans should be readily saleable for human consumption, and that their value in London would be £10 a ton (June 1910).

No. 15. *Variety* "**Butter Beans.**" Large flat beans about ⅞ inch long, of cream colour with a distinct tinge of green. Slight wrinkled striations were observed, spreading from the hilum.

	Per cent.		*Per cent.*
Moisture . . .	12·23	Fibre	4·39
Crude proteins . .	17·68	Ash	3·64
Fat	1·06	Nutrient ratio . .	1 : 3·59
Starch etc. . .	61·00	Food units . . .	107·8

The commercial experts reported that this sample was of poor quality, the beans being damaged, but that in good condition the product should realise £13 to £15 per ton in London (February 1910).

No. 16. *Variety* "**Butter Beans**," **2**. Large, flat, somewhat crinkled beans, about ¾ inch long, and of cream colour with brownish spots. The sample was slightly weevilled.

	Per cent.		*Per cent.*
Moisture . . .	12·23	Fibre	4·51
Crude proteins . .	18·50	Ash	4·20
Fat	0·99	Nutrient ratio .	1 : 3·35
Starch, etc. . .	59·57	Food units . .	108·3

The commercial experts who examined these beans reported that they were of poor quality for butter beans, being thin and shrivelled, and in this condition would not be worth over £11 per ton in this country. If good quality beans in better condition were shipped they would probably realise about £14 per ton (February 1910).

GENERAL CONCLUSIONS.

For the purpose of comparison with the foregoing analyses the composition of a number of typical leguminous seeds, imported to the United Kingdom for use as foods or feeding stuffs, is given below:—

	Indian peas (unhusked).	Lentils (unhusked).	Haricot beans.	Indian gram.	Rangoon beans (white).
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	12·5	11·7	14·0	10·8	13·3
Crude proteins . .	23·6	24·9	23·0	22·2	19·7
Fat	1·3	1·5	2·3	2·7	1·2
Starch, etc. . .	54·5	56·0	52·3	54·1	57·8
Fibre . . .	5·7	3·6	5·5	5·8	4·3
Ash	2·4	2·3	2·9	4·4	3·7
Nutrient ratio . .	1 : 2·4	1 : 2·5	1 : 2·5	1 : 2·7	1 : 3·2

It will be observed that in most cases the present samples of East African beans agree closely in composition with well-known leguminous seeds already on the market in this country.

FUNTUMIA RUBBER FROM WEST AFRICA.

CONSIDERABLE attention has been devoted recently by the Agricultural and Forestry Departments in West Africa to the question of the improvement of Funtumia rubber, and several new methods of coagulating the latex have been suggested. One of the simplest processes consists in boiling the diluted latex and then rolling the freshly coagulated rubber into biscuits. Specimens of Funtumia rubber prepared by this method in the Gold Coast and Southern Nigeria have been examined recently at the Imperial Institute, and the results are given in the following account.

GOLD COAST.

(1) "Rubber prepared by boiling, No. 1." This sample was the portion of rubber, which coagulated first on boiling the diluted latex. The sample weighed $1\frac{1}{4}$ lb. and consisted of nine biscuits of light-brown rubber marked by dark patches. The rubber was clean and very well prepared; it exhibited good elasticity and tenacity.

An analysis gave the following results:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	0·8	—
Caoutchouc	9·8	90·5
Resin	7·0	7·1
Proteids	2·0	2·0
Ash	0·4	0·4

The biscuits were valued at 6*s.* to 6*s.* 6*d.* per lb. in this country, with fine hard Para quoted at 7*s.* 7*d.* per lb. and Ashanti Lump at 1*s.* 11*d.* to 2*s.* 3*d.* per lb.

This rubber is of very good quality, the dry material containing over 90 per cent. of caoutchouc, whilst the amounts of resin

and proteid are satisfactorily low. The value of the rubber would be enhanced if the formation of the dark patches on the biscuits could be avoided. This discoloration has probably developed during drying, and might be prevented by drying the biscuits more quickly.

It is evident that Funtumia rubber prepared by this method will command prices greatly in excess of those realised by Gold Coast Lump. The use of the process by the natives should therefore be encouraged. Care must, however, be taken that the coagulated rubber is not over-heated, as it thereby becomes sticky and depreciated in value.

(2) "Rubber prepared by boiling, No. 2." This sample was the portion of rubber which coagulated last on boiling the diluted latex. It weighed only 1½ oz. and consisted of nine thin sheets of light-brown rubber, very similar in all respects to the preceding specimen No. 1.

The rubber had the following composition:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	0·5	—
Caoutchouc	88·0	88·5
Resin	9·2	9·2
Proteids	2·0	2·0
Ash	0·3	0·3

The sample was too small for separate valuation, but it would probably be worth about the same price as No. 1.

This rubber contained 2 per cent. less caoutchouc and 2 per cent. more resin than No. 1, so that it was not quite so satisfactory in composition as the latter.

SOUTHERN NIGERIA.

"*Funtumia elastica* biscuits." The sample weighed about 14 oz. and consisted of 12 small biscuits of light-brown rubber, rather rough in appearance but clean and well prepared. Most of the biscuits were thoroughly dry, but a little moisture was present in some of the thicker biscuits, which were marked with opaque patches. The elasticity and tenacity of the rubber were very good.

A chemical examination furnished the following results:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	0·4	—
Caoutchouc	88·0	88·4
Resin	9·0	9·0
Proteids	2·2	2·2
Insoluble matter	0·4	0·4
Ash	0·4	0·4

The rubber was valued at 8*s.* per lb. in London with fine hard Para at 10*s.* 6*d.* per lb., and Lagos and Benin Lump (selected) at 4*s.* 11*d.* to 5*s.* 3*d.* per lb.

This rubber is of satisfactory composition, containing over 88 per cent. of caoutchouc in the dry material. The percentage of resin is, however, a little high.

It will be seen from the valuation obtained that this Funtumia biscuit rubber would realise about 3*s.* per lb. more than selected Lagos and Benin Lump rubber.

LANDOLPHIA RUBBER FROM THE SUDAN.

A SMALL consignment of rubber from the Bahr-el-Ghazal was forwarded recently to the Imperial Institute by the Sudan Government for examination and subsequent sale. The rubber was derived from the indigenous rubber-vine, *Landolphia owariensis*, var. *tomentella*, and it had been prepared in biscuits or sheets as recommended by the Imperial Institute in previous reports.

Description of Consignment.

The rubber biscuits and sheet varied in colour from pale to dark brown. Representative samples were retained for examination and exhibition at the Imperial Institute, and the remainder was sorted according to quality into 4 lots, which were classified by the brokers as follows:—

(1) Rough, irregular biscuits, well cured and, in fairly good condition, strong and clean. 150½ lb.

(2)	Similar to (1), but rather inferior.	318 lb.
(3)	Pale biscuits, much better cured than (1) and (2), strong and in good condition.	160½ lb.
(4)	Pressed sheet.	23 lb.

The whole of the rubber was coated with powdered talc, which had no doubt been added to prevent the biscuits from adhering together.

Results of Examination.

A chemical analysis of representative samples of the dark and light biscuits gave the following results:—

	Rubber as received.		Composition of dry rubber.	
	Dark. *Per cent.*	Light. *Per cent.*	Dark. *Per cent.*	Light. *Per cent.*
Moisture	0·4	0·3	—	—
Caoutchouc	93·2	92·4	93·6	92·7
Resin	4·4	5·6	4·4	5·6
Proteids	0·5	0·5	0·5	0·5
Ash	1·5	1·2	1·5	1·2

These figures show that so far as chemical composition is concerned the rubber is of very good quality, the two samples containing 92·7 and 93·6 per cent. of caoutchouc in the dry material. The amount of proteid is extremely low in both specimens and it is noteworthy that the percentage of resin is higher in the light rubber than in the dark.

Commercial Value.

The consignment of rubber was sold in London at public auction and realised prices ranging from 6*s.* 9*d.* to 8*s.* 4*d.* per lb. The price of fine hard Para rubber on the day of the sale was 10*s.* 4*d.* per lb.

The brokers who sold the consignment reported that the rubber was exceptionally strong, and that with a little more care in preparation, it should realise prices comparing favourably with those of Eastern plantation rubbers.

GENERAL NOTICES RESPECTING ECONOMIC PRODUCTS AND THEIR DEVELOPMENT.

MAURITIUS HEMP.

THERE are several plants belonging to the natural order *Amaryllidaceæ* which yield fibres of considerable commercial importance. These plants are commonly, but erroneously, termed "aloes." Foremost among them are the different species of *Agave* from the leaves of which Sisal hemp and allied fibres are obtained. The cultivation and extraction of Sisal hemp have been already dealt with in this *Bulletin* in several articles (1903, 1. 201; 1904, 2. 260; 1907, 5. 28, 422; 1908, 6. 212). Another plant of this class also largely grown for the production of fibre is *Furcræa gigantea*, the "aloës vert" of Mauritius, which yields the product known in commerce as "Mauritius hemp." This fibre is produced in commercial quantities only in the island of Mauritius, although there is no doubt that it could be readily grown in many other countries.

Furcræa gigantea occurs widely in tropical America, and has been introduced into Mauritius, St. Helena, India, Ceylon, Algeria, Natal, Nyasaland, the East Africa Protectorate, Uganda, Rhodesia, the West Indies, and parts of Australia.

The plant has a habit similar to that of an *Agave*. The trunk below the rosette of leaves attains a height of from 2 to 4 feet. The leaves are from 4 to 7 feet long and from 5 to 8 inches broad at the middle. They are of a bright green colour, are channelled down the face and bear no marginal teeth or terminal spines. The flowers are greenish-white and are borne on a branched peduncle or "pole," which reaches a height of 10 to 20 feet. As in the case of the *Agaves* and the other species of *Furcræa*, the "pole" bears numerous oblong bulbils which, on falling to the ground, take root and reproduce the plant. Propagation is chiefly effected by this means. The life of the plant is usually about 7 to 10 years, and leaves can therefore be cut for about 4 or 5 years before the plant "poles" and afterwards withers and dies. The plant is said to be hardier than any other fibre plant of its class, and to be able to flourish under a greater diversity of conditions of soil and climate.

It is stated that *Furcræa gigantea* was first introduced into Mauritius from South America about the year 1790, as an ornamental garden plant. In 1837 it had established itself in several parts of the island, and, although receiving no attention, it gradually spread over waste lands and abandoned sugar estates, until in 1872 the plants were so abundant as to suggest their utilisation for the extraction of fibre. An industry was started about the year 1875, and has continued up to the present time.

There is little, if any, systematic cultivation practised in Mauritius, but the plant is found more or less in all parts of the island, and especially on the uncultivated coast lands. The plant reproduces itself by means of the bulbils, which fall to the ground in sufficient quantities to ensure the rapid multiplication of the plant. Such bulbils as find themselves in satisfactory conditions take root and grow to maturity, but, although these may be but a comparatively small proportion of the whole, they are nevertheless always too numerous and too close together, and are consequently unable to develop normally. Moreover, the lands on which the plant grows are overrun with *Lantana* and *Leucæna glauca*, so that the conditions are far less satisfactory than they would be in well-kept plantations.

Two forms of *Furcræa gigantea* occur in Mauritius, and are known as "l'aloës malgache" and "l'aloës créole." It is not known if these are two distinct varieties, but they can be easily distinguished especially when growing in the same locality. "L'aloës malgache" is more abundant at Réduit, whilst in the older coast plantations "l'aloës créole" is chiefly encountered. The leaves of "l'aloës malgache" are thicker especially at the base than the leaves of "l'aloës créole." A comparative trial with leaves of the two kinds gave results which indicated that the "aloe" of the coast regions yielded more fibre than the "aloe" of Réduit.

The lands on which *Furcræa* grows are mostly in the hands of coolies, who cut the leaves and sell them to the mill-owners. Usually a price of about 25–30 sous is paid for 100 bundles of leaves, each containing from 6 to 20 or even 25 leaves, and weighing from 7 to 12 or up to 15 kilos. The average weight of a bundle is, however, about 10 kilos. The same price

is paid for the leaves whatever the market value of the fibre, and hence the raw material required for the production of a ton of fibre worth from 300–350 R. (£20–£23) costs only about 12–15 R. (16*s.*–20*s.*). The chief items in the cost of production of a ton of fibre are of course the cost of extraction, labour and transport, but nevertheless the price of 25 sous offered for 100 bundles of leaves is much too low. If the fibre manufacturers desire to see the cultivation extended and the supply of their raw material increased, they ought to offer a remunerative price and one which would be proportional to the selling price of the fibre. The cultivators would then, perhaps, create new plantations, and tend them carefully in order to increase the yield and diminish the cost of cutting and collecting the leaves.

The cost of transporting the leaves to the factory is very considerable when the leaves have to be carried great distances, and in some cases it would probably be economical if the fibre could be extracted on the spot, so that only about 1/10 part of the weight would have to be transported. With the ordinary small machine now in use, an installation might be very serviceable, which could easily be moved from place to place and enable the fibre to be extracted on the land on which it grows. One machine only requires 2½ H.P. and the use of a small locomotive on which it could be carried would permit of the exploitation of aloe plants, which now occur at too great a distance from the factories to be utilised.

The machine usually employed in Mauritius for the extraction of the fibre is known as the "gratte" or "scraper," and is manufactured in the Colony. It somewhat resembles the raspador which is so largely used in Mexico for the preparation of Sisal hemp. The machine costs about 250 R. without the motor, and requires the services of two men.

The following description of the machine and mode of extracting the fibre, by M. Regis de Chazal, Engineer to the *Forges et Fonderies de Maurice*, has been published in the *Kew Bulletin*, 1890, pp. 101–103 :—

"*Description of Machine.*" The machine generally in use in Mauritius for extracting fibre from the leaves of the green Aloe (*Furcræa gigantea*) is known under the name of *gratte*. This gratte consists of a drum about 2 feet in diameter and 1 foot

wide. On the circumference of this are bolted 2-inch L-shaped blades parallel to the axis. These blades are generally of iron, but steel is preferred. They are firmly fixed to the drum by means of bolts and nuts. The drum is mounted upon an axle and made to revolve with great rapidity close to and against the front or edge of a feed table (*servante*). The feed table is adjusted by means of screws so as to approach the revolving drum within a distance of quarter inch to an inch, as required. It is composed of a stout brass plate and lip fitted firmly to a piece of hard wood by means of a bolt. The plate and wood are themselves fixed to two wooden bars, 6 inches by 6 inches, which serve as guides in the movement of the feed table backwards and forwards.

"The most difficult task in connection with working the gratte is the exact adjustment of this feed table. It is most necessary that the blades on the drum and the edge of the feed table are so adjusted that they work freely and evenly, and at the same time bring every fibre in the leaf in contact with the beaters. The proper adjustment of the feed table in regard to the beaters is stated to be the secret of the success of the *gratte* as a fibre machine. This adjustment should be performed with the utmost care before the machine is started. When once adjusted it is important to maintain the feed table in its proper position and prevent any displacement during the process of working.

"The drum should be turned at an average rate of 700 revolutions per minute; while a higher rate of speed may be maintained without injury, it is found not desirable under any circumstances to fall below 620 revolutions per minute. The best and most economical work is that done at 700 revolutions per minute.

"*Method of Working.*—The aloe leaf is presented tip first along the feed table, and is drawn down between the latter and the drum. It is thoroughly beaten by the grattes to about three-fourths of its length. By these means the pulp is removed and the fibre is left. The leaf is then withdrawn and the other end presented to the beaters until the whole is cleaned.

"Two men usually work at each machine. They stand one on each side of the feed table and work alternately. It is

desirable for rapid work that one of the men should be left-handed. Each man in turn presents his leaf to the machine and withdraws it as soon as possible. In a regular and efficient working of the machine it is arranged that one man or the other should always have a leaf in the machine in course of being cleaned. To avoid accidents the feed table is now provided with a wooden guard. This guard prevents the hands of the workpeople from being caught by the beaters.

"*Mounting the Machines.*—The machines are generally mounted in pairs, both working on the same axle, and driven by steam or water power. The driving wheel, fixed midway on the axle between the two machines, should have a minimum diameter of 18 inches, with a strap 6 inches wide. A single adjustment of the feed table should last from 8 to 15 days. At the end of that time it is generally found necessary to readjust the parts to ensure good results.

"The framework of the machine is securely attached to substantial masonry work by large bolts about 5 feet long. The machines must be thus firmly secured or the vibration during the process of working would soon cause them to become detached. The arrangement of the machines in pairs on the same axle could be extended in the same line indefinitely, provided the necessary distance is preserved between the centre of each machine. One of the largest fibre factories in Mauritius contains twelve machines; that is, six pairs arranged as already described.

"*Treatment of the Fibre.*—When the fibre first leaves the scraping machine it is covered with mucilage, possessing corrosive properties, which dries on exposure to the air. The tendency of this mucilage, if left on the fibre, is to turn it a yellow, and sometimes even a reddish colour. To prepare the fibre with a bright attractive appearance the best plan is to place it, as soon as it leaves the machine (or as soon as it has been weighed, to check the amount produced by each man), in warm water of a temperature of 60° to 80° C. (140° to 176° F.), and leave it there for about two hours. It should then be washed in two waters, and finally exposed to the sun to be dried.

"A treatment recently employed consists in washing the fibre in cold water only. In the first washing, soap is used at

the rate of 2 to 3 per cent. of the wet fibre. After being thoroughly washed with soap the fibre is passed through pure water until all the soap has disappeared, then exposed to the sun and dried. By these means a beautifully white fibre is obtained. When thoroughly dried the fibre is afterwards scutched, to get rid of pith and dust. This process is usually performed by a machine constructed on the plan of an ordinary *gratte*, but fitted with four blades instead of twelve. These also turn away from the feed table instead of towards it. The fibre is inserted at an opening about 6 inches higher than the centre of the axle. It is carried away by the movement of the beaters, and remains on the top of the drum, where, exposed to the repeated blows of the beaters, it is cleaned of all dust and impurities.

"It may be mentioned that, owing to the corrosive nature of the juice of the aloe leaves, the workpeople are compelled to wear strong leather gloves. The gloves are fastened to the wrist by leather bands. As the gloves are provided by the proprietor, and they wear out very quickly, they constitute quite an appreciable item in the cost of working a fibre factory."

The yield of dry fibre from the fresh leaves usually varies from 2 to 2·5 per cent., whereas in the case of Sisal hemp a yield of about 3·5 to 4 per cent. is obtained. It is not possible to estimate the yield of Mauritius hemp obtainable per acre, since the plant is not grown and cultivated in regular plantations, but it is probable that one acre of planted *Furcræa* would give about 50,000–60,000 leaves, yielding from ½ to 1 ton of marketable fibre.

There are between 30 and 40 fibre factories in Mauritius, about half of which are worked by water-power through the medium of the antique water-wheel. The quantities and value of the fibre exported during the years 1894–1908 are given in the following table:—

	Tons	£		Tons	£
1894	844	11,435	1902	2,111	60,120
1895	1,291	27,116	1903	1,495	35,335
1896	950	16,889	1904	1,890	40,225
1897	1,165	16,167	1905	1,648	36,202
1898	1,472	28,475	1906	1,919	47,282
1899	2,214	37,735	1907	2,834	63,231
1900	3,056	62,695	1908	2,108	39,966
1901	1,223	22,623			

It is evident from these figures that the prices obtained for Mauritius hemp are liable to considerable variation. These fluctuations, like those of Sisal hemp, take place in accordance with the Manila hemp market. The values of all these fibres were very high at the end of 1905 and the beginning of 1906, when "good fair" Mauritius hemp was quoted in London at about £30 per ton. The price fell rapidly during 1907, until in March 1908 it had reached £19 10*s.* per ton. The value then remained fairly constant, fluctuating between £19 and £21 10*s.* until the latter part of 1909, when a gradual rise took place. At the present time the market value is about £26–£27 per ton.

Mauritius hemp resembles Sisal hemp in its general properties, but is usually somewhat finer, softer and weaker than the latter. It is chiefly employed for rope manufacture and especially for mixing with Manila and Sisal hemps for the production of medium grades of cordage.

It does not seem likely that any great extension of the *Furcræa* industry will take place in Mauritius. There is no doubt, however, that if plantations were established the cost of cultivation and upkeep would be very small and would be largely compensated by the diminution in the cost of collection and transport of the leaves, which actually forms a considerable proportion of the cost of production owing to the plants being distributed over wide areas and often at a great distance from the factory. It has been recommended that in Mauritius the plants should be laid out in rows about 4 or 5 feet apart, and with the same distance between successive plants in each row. It is stated that the leaves can be cut about four years after planting, a second crop can be obtained ten months after the first, a third crop 15 months later, and further crops every 18 months until the plant dies.

In considering this question of establishing plantations with the object of creating a regular exploitation, the question arises as to whether it would not be more profitable to grow Sisal hemp than *Furcræa.* The advantages of Sisal hemp are that it usually realises a slightly higher price than Mauritius hemp, and that the leaves yield a larger percentage of fibre. On the other hand the *Furcræa* plant can be cut at an earlier age, lives for a

longer period, and the leaves are free from spines. Duri recent years Sisal plantations have been made in Mauritius, a it appears probable that the fibre industry will develop in t direction.

About thirty years ago, *Furcræa gigantea* was introduced ii Natal and has since spread along the coast lands. A seri attempt was made about twelve years ago to cultivate the pl in the vicinity of Port Shepstone. Plantations were establish encouragement was given to the settlers to plant small ar with this crop, and a mill was erected and equipped with t needful machinery. The plantations were afterwards neglect but were reclaimed in 1906. Various types of extracti machinery were tried, and finally the Finigan-Zabriskie mach was adopted. The transport of the leaves to the factory v found to be a heavy expense, but this could have been consid ably reduced, either by laying down tram-lines or erecti machinery in the plantations. With regard to the collection the leaves, it was found that the best results were secured cutting from seven to nine leaves each month. The yield v found to be about ¾ ton of dry fibre per acre. It has be suggested that many of the "thorn lands" in the upper p of the country would be suitable for *Furcræa*, and it is stated tl there are immense areas which are not fit for any other crop account of the stony soil and low rainfall. It has also be proposed to encourage natives to grow the plant in shelte spots in the locations. The opinion has been expressed tl *Furcræa* is more profitable to grow in Natal than *Agave* on fairly good soils, but that the latter plant may be more successful on the lighter and more sandy soils. This view is based on a comparison of the production of leaves per acre, the percentage yield of fibre, and the duration of life of the plants.

Furcræa gigantea also grows well in Nyasaland and produces fibre of excellent quality throughout the Protectorate up to elevations of 2,900 feet. During the year 1910, 1,048 acres have been planted with this crop, and 270 acres are ready for cutting. The crop for 1909 amounted to 24½ tons, and that for 1910 is estimated at 29 tons.

Samples of the fibre of *Furcræa gigantea* from the East Africa Protectorate, Uganda, Nyasaland, Southern Rhodesia, Natal,

St. Helena, India and South Australia have been examined at the Imperial Institute, and an account of the results obtained and the quality and value of the fibres has been published in "Colonial Reports—Miscellaneous, No. 58. Selected Reports from the Scientific and Technical Department of the Imperial Institute. I. Fibres. [Cd. 4,588.]"

Another species, *F. cubensis*, grows readily in Tobago and Trinidad and in many other tropical countries, and is said to yield a strong, lustrous fibre. The yield of dry fibre varies from 2 to 3 per cent. of the weight of the fresh leaves. Samples of the fibre of this plant have been forwarded to the Imperial Institute from Sierra Leone, and have been submitted to examination. The results of the investigation will be found on page 86 of the publication referred to above.

BURMESE BLACK VARNISH OR LACQUER.

IN a previous number of this *Bulletin* (1910, 8. 32) a *résumé* of information was given regarding the natural varnishes of China and Japan. That article is now supplemented by an account of a similar product obtained and used in Burma.

The principal constituent of Burmese lacquer, or "thitsi," is an oleo-resin obtained from the "Black Varnish Tree" (*Melanorrhœa usitata*, Wallich), a deciduous species 50–60 feet high, which frequents open forests, composed principally of "Eng" or "In" (*Dipterocarpus tuberculatus*), but is rarely met with in drier regions. The tree occurs in the native state of Manipur, which lies between Assam and Burma; in Burma from Prome, Pegu, and Martaban down to Tenasserim and also in Siam. It ascends to 3,000 feet elevation, and would probably succeed in situations with a temperate climate free from frosts.

To obtain the varnish "V"-shaped incisions are made in the bark of the tree by means of an iron chisel of peculiar shape. The two sloping cuts forming the "V" are about 9 inches in length and 5 inches apart at the upper end, meeting at the point of union at an acute angle. A bamboo collecting-cup, about 6 inches in length, with a slanting mouth, is driven into the bark

of the tree at the base of the incisions, and the exuding sap, a thick, viscid, greyish fluid is caught in the tube. After about ten days the exudation from the wound ceases, and the contents of the collecting-cup are emptied into another vessel. A fresh slice is cut off the triangular piece of bark formed by the two sloping cuts, and the collecting-cup is fixed higher up the tree near the new scarification. The sap continues to exude for another ten days, after which time the wound is abandoned. The tapping takes place all over the trunk of the tree and the principal branches; as many as 40 or 50 scars have been noted on one tree, some being at a height of 30 feet from the ground. The amount of varnish yielded varies considerably; old trees appear to produce more than young and vigorous specimens. The best time for tapping is from July to October. When the trees are leafless during the hot season they yield no sap. It is estimated that one collector can obtain from 40 to 50 viss (146–182 lb.) of varnish in a season.

The chemical composition of "thitsi" or Burmese varnish has recently been the subject of investigation by Mr. Puran Singh, Acting Imperial Forest Chemist in India, and the results are published in the *Indian Forest Records*, 1909, vol. i., part iv. It appears that the most important constituent of "thitsi" is urushic acid, which forms about 85 per cent. of pure samples, and that this and the other principal constituents are identical with those of Japanese lacquer. Further experiments by the same investigator proved that the moist atmospheric conditions essential in the hardening process of Japanese lacquer are also necessary in the case of "thitsi."

In Burma "thitsi" is used for a variety of purposes. In a liquid state it is often employed as a varnish on wood-work, or utilised to render paper or cloth waterproof, as is the case in the manufacture of the characteristic Burmese umbrellas. Coloured with vermilion, orpiment or indigo, it is used to ornament various articles of domestic or religious use. Ashes or teak sawdust are mixed with it to form a kind of putty, which is used on wood-work or basket-ware to form a foundation on which finishing coats of varnish are afterwards laid. It is also used as a cement, and is largely employed for this purpose in the manufacture of the glass mosaics used in the decoration of Buddhist temples.

Manufacture of Burmese Lacquer-ware.

There are several kinds of "thitsi" lacquer-work which are produced at different centres, each of which has a peculiar style. The most distinct are the lacquered basket-work of Pagan, the Prome gold-lacquered ware, the moulded lacquer-ware of Mandalay, and the Manipur varnished ware.

In Pagan ware the foundation of the lacquered article is either basket-work or plaited horse-hair. The basket-work consists of finely divided stems of a bamboo (*Cephalostachyum pergracile*), which are closely woven over a mould. This basket-work is so skilfully done that such articles as cylindrical boxes, circular trays and covers can be afterwards turned on a lathe. To prepare the basket-work to receive the lacquer the meshes are filled with a rough clay, ashes or sawdust, mixed with inferior kinds of "thitsi." Over this a thick coating of raw "thitsi" is applied, which binds the whole together, and the article is then placed in some cool and shady place or in an underground cellar to harden. After three or four days the lacquer has set and the article is then placed on the chuck of a bow-lathe and ground down with stones of graduated fineness, until a perfectly smooth surface is obtained. Many coats of lacquer are applied, and after each has hardened a process of rubbing down and polishing is carried out. The finishing coats of lacquer are next applied, and these are frequently coloured. If the article is to be further ornamented it is placed on a lathe and the gloss of the polished surface removed. It is then handed to the engravers, who etch the design on the groundwork by means of a metal style. A coating of coloured lacquer is then rubbed over the design, and after this has hardened the article is turned on a lathe and the excess of coloured lacquer removed. The etched lines of the design are the only parts which retain the second colour. If several colours are used in the design, only those parts that are to appear in the same colour are etched at one time, and after the application of each colour the excess of lacquer is removed by turning the article on the lathe. Four colours are in general use; these are black, red, yellow and green. Black is produced by using the varnish in a pure state; red is obtained by mixing it with vermilion, yellow by orpiment, and green by adding indigo to the yellow. When the design is

completed, two or three finishing coats of fine varnish are applied and polished.

In the Prome gold lacquer-ware the early stages of manufacture are similar to those already described for Pagan ware. After a perfectly smooth groundwork has been obtained, the article is re-varnished, and before the "thitsi" has become hard, gold leaf is applied and adheres firmly. The plain gold-lacquered wares are produced in this way. If a design is required it is painted on the groundwork with a mixture consisting of finely powdered orpiment and gum. Gold or silver leaf is then applied to the whole surface, as in the case of the plain wares, and after this has set the article is washed in water, which removes the orpiment paint and reveals the design in black on a gold or silver ground.

The ornamental moulded lacquer of Mandalay is done over a foundation of basket-work or wood, the preparation of a smooth groundwork being carried out on lines similar to those previously described. The moulding material consists of "thitsi" mixed with rice-husk, cow-dung ashes, or finely powdered bone-ash. The ornamental work, moulded by hand on a soapstone slab, is transferred piece by piece to the surface to be ornamented; finishing touches are given with wooden modelling tools before it is set. A coating of "thitsi" is then applied all over (no other fixing being required), and the article is placed in a moist place to harden. In some cases where the design is in low relief a layer of the moulding material is spread on the surface to be ornamented, and whilst in a plastic state a soapstone mould is pressed on the top of it. When this is set it receives a coat of fine "thitsi," and presents the appearance of a finely carved panel of ebony. This form of ornamentation is rapid and easy, and suggests a more extensive use. In Manipur, where the varnish is known as "kheu," articles of wood, stone, metal or leather are coated with it. The raw varnish is usually mixed with cow-dung ashes for the primary coats, and, after hardening in a moist place, the rubbing down with stones of various grades takes place. The articles are then soaked in cold water, and rubbed with the rough leaves of *Ficus cunia* until a surface of the required degree of smoothness is obtained. The finishing coats of pure varnish are then applied, and

between each application the process of soaking in water and rubbing down with leaves is carried out. Leather articles treated in this way take a rich black polished surface, and have the appearance of patent leather goods.

In Burmese glass mosaics the use of "thitsi" as a cement is well illustrated. After the groundwork has been prepared in the usual way, it is varnished with "thitsi" and allowed to dry. The design is then sketched in chalk, and pieces of coloured or mirror glass cut to the required shape. Each piece of glass receives a coat of "thitsi" on the back, and is pressed firmly into the position it is to occupy. Thin strips of a putty, composed of "thitsi" mixed with sawdust, are then placed round each piece of glass, and serve not only as a binding, but also assist the design. The whole receives a coat of "thitsi," and before this has hardened, the mouldings are coated with gold leaf and the glass surfaces cleaned. The mosaic of coloured glass sets firmly, is remarkably durable, and presents a very showy if sometimes gaudy appearance.

In better-class work the "thitsi" is boiled, then sprinkled with water and allowed to cool. Ashes are then thoroughly mixed with it until a plastic material of the right consistence is obtained. Mouldings are then formed and placed in position on the surface to be ornamented. Small pieces of coloured or mirror glass are inserted in the plastic moulding material and a final coat of "thitsi" applied all over. If it is to be gilded, the gold leaf is pressed on the varnished surface before it has quite hardened.

In the paper previously referred to, Mr. Puran Singh suggests that in order to improve and develop the Burmese lacquer industry, greater care should be taken in the preparation of the lacquer, and he recommends that the Japanese methods already described should be adopted. With the artistic ability of the Burmans and a material at hand which has been proved to equal that used by the Japanese workmen, it is reasonable to assume that a much more important lacquer industry could be developed in Burma than that existing at present.

Samples of "thitsi" lacquer and specimens of various styles of Burmese lacquer-ware and glass mosaics are shown in the Indian galleries of the Imperial Institute.

THE DISTRIBUTION AND UTILISATION OF CHROMIUM ORES.

IN previous numbers of this *Bulletin* articles have been published giving information regarding the occurrence and utilisation of ores of a number of the less common metals, such as tantalum, vanadium and tungsten, which have in recent years acquired certain technical importance on account of their application in steel manufacture or in other special branches of industry. Though chromium and its ores are much better known than the products just referred to, it seems worth while, at the present juncture, to give a similar *résumé* of information regarding this metal, since it has also found application in the manufacture of hard steels, and a number of important new applications of its compounds have been made in recent years. Further, interest also attaches to this metal from the point of view of readers of this *Bulletin*, since a number of deposits of chromium ores have been discovered of late in British Colonies.

ORES OF CHROMIUM.

The chief chromium ore of commercial importance is chromite, a compound of ferrous oxide with chromium sesquioxide, containing, theoretically, the equivalent of 46·4 per cent. of metallic chromium. One or both of the metals may be replaced to a greater or less degree by magnesia, alumina, silica or lime. The mineral crystallises in octahedra, and has usually an iron-black colour, but a brown streak, a sub-metallic lustre, hardness about 5·5 and specific gravity 4·32 to 4·55. It is sometimes feebly magnetic. Chromiferous iron ore is also employed as a source of chromium, and has lately been mined in Greece to some extent. It may contain up to the equivalent of 50 per cent. of iron, and varying amounts of chromium up to about 3 per cent. These two minerals constitute the only ores at present utilised on a large scale as a source of chromium, but there are several minerals which carry small percentages of chromium, such as picotite (chrome spinel), crocoisite (PbO,CrO_3) (chrome yellow), chrome diopside, chrome garnet, chrome mica, etc.

OCCURRENCE OF CHROMITE.

Deposits of this mineral of commercial importance are not very numerous; for although there are many localities in which the mineral occurs, the deposits are often of too low a grade to be worth working, or the mineral is associated with impurities from which separation is difficult, or the cost of transport is too high to permit of their successful exploitation. Chromite *in situ* is usually found in a granular state in very basic igneous rocks rich in magnesia, such as peridotites consisting mainly of olivine and their alteration product, serpentine.

The mineral is also found in alluvial deposits in many parts of the world, but most of these are of too low grade to permit of successful working, exceptions being certain deposits in New Caledonia and Asia Minor. Platinum often occurs with chromite in alluvial deposits; this is particularly so in the case of those on the eastern slopes of the Urals, and the metal has been found in some of the chromite deposits of California.

The chief sources of supply of chromite are the deposits of New Caledonia and Asia Minor, and the market is at present practically controlled by the production from these areas. Owing to the fact that deposits of chromite are nearly always of a pocket-like character, the mining of this material is attended with uncertainty, and so estimates of the amount of ore available, beyond that exposed, are of little value. The pockets may or may not be connected with one another, and so a large amount of unprofitable work may have to be done before a new supply is located after one source has been worked out.

Europe.

Austro-Hungary.—Although serpentine occurs in many localities in Austro-Hungary, chromite is not found in abundance in many places. In Upper Styria, near Kraubach, the ore has been worked in the Gulsen Hill, where it occurs irregularly in small bunches and stringers which have been developed by means of open cuts. It usually requires concentration to bring it up to marketable standard. Good quality ore occurs in Bosnia and has been mined for use as a furnace lining. It has been located in serpentine from Banjalecka to Varesh on the Servian

frontier. The ore is most abundant near Dubostitza, where deposits occur over an area of 114 square kilometres. Chromite occurs in paying quantities in serpentine at Orsova in Hungary. The ore is of low grade, shipments averaging about 40 per cent. of chromium sesquioxide. The ore occurs in an extensive area of serpentine on the left bank of the Danube, and has been worked, to a small extent, by means of open cuts at Ogradina, Dubova, Plavishevitza, Tsoritza, and Eibenthal.

United Kingdom.—Chromite occurs in Banffshire at Portsoy, and in the Shetland Islands, Unst, and Fetlar. The deposits of Unst are on the North side of Balta Sound, in a series of large nodular masses, which seem to be connected. In a quarry between Heog and Keen Hills the ore forms a mass 86 feet deep and 60 feet wide. A large amount of work has been done on a deposit at Sobul Hill.

Norway.—There is a small production of chromite from Drontheim and Roeraas.

Germany.—In lower Silesia there are situated large deposits of low-grade chromite. One of these occurs on the southern slope of Mount Zobten between Schweidnitz and Jordansmuchl. The ore occurs with varying quantities of magnetite in serpentine, and carries from 35 to 42 per cent. of chromium sesquioxide, 19 to 22 per cent. of alumina, and the same quantities of ferric oxide. Some work has been done on the deposit, but owing to the low grade of the ore and its unsuitability for use as a refractory material, the work has been abandoned. In Upper Silesia, veins of chromite have been found in serpentine near Frankenstein, but their exploitation has not been a commercial success.

Greece.—A large quantity of chromiferous iron ore has been produced lately in this country. The more important deposits are situated to the north of Athens, Boeotia and Locrida being noteworthy places in this respect. The ores carry the equivalent of 50 per cent. of iron and about 2·5 per cent. of chromium, and are found in veins associated with serpentine, which have been injected into the white and yellow limestones. From the concessions held by one company, north of Mount Ptoon, 185,000 tons of ore was exported in 1907. Chromite ores carrying 30 to 50 per cent. of chromium sesquioxide are exported from the

Lamia district, where there exist important deposits of the mineral, which have been but little worked, so far.

Russia.—Chromite is produced in large quantities from the Ural district, the principal regions being on the banks of the Kamenka and Topkaja. There are about fifty chromite mines in the district, whose combined annual output reaches about 25,000 tons. Chromite occurs in large granular masses near Ekaterinburg, about eight miles from Bisserk and also near Kyschtinsk. A factory for the manufacture of bichromates is situated near Elabougi, on the river Kama, and consumes about 2,000 tons of ore per annum.

Asia.

Asia Minor.—For many years the bulk of the chromite produced came from Asia Minor. As a general rule the ores are very soft, low in silica, and fairly rich, containing over 52 per cent. of chromium sesquioxide, and for these reasons find favour for the manufacture of bichromates, for which purpose the ores must be finely ground. The ores of New Caledonia have, however, largely replaced those of Asia Minor owing to better internal transport facilities, lower ocean freights, and lower taxation. A large number of deposits occur to the south of Broussa in the Province of Aidin, this ore being shipped from Smyrna. The deposits of Makri, which at one time produced 30,000 tons annually, are interesting in the fact that the quality of the ore, which occurs in pockets and veins of irregular size, deteriorates with depth. Other important deposits occur at Harmanjack (15 miles north of Broussa) and at Antioch.

India.—A large proportion of the chromite produced in India comes from Baluchistan, where it is obtained in the Quetta-Pishin and Zhob districts. The ore occurs in veins and irregular segregated masses in the serpentine which accompanies the great basic intrusions of Upper Cretaceous age amongst the hills bordering the Upper Zhob valley, both to the north and south. There are indications that these deposits may continue along the Lower Zhob, as far as the Tochi Valley.

A very promising deposit has been located about two miles east of Khanozai, in the Pishin district, where a vein-like mass of rich chrome ore about 400 feet long, and having an average

breadth of 5 feet has been found. The ore, on analysis in the laboratory of the Geological Survey, was found to contain 54 per cent. of chromium sesquioxide. The locality is connected by a good road with the Khanai railway station, about 17 miles distant. In the Andaman Islands, near Port Blair, in the village of Chakargaon, large loose blocks of chromite have been found, but no ore has been located *in situ*. In Bengal, chromite has been located recently in Singbhum, in serpentine at the Sura pass, on the road from Chaibasa to Sonua. Twelve small excavations have been made, and in all of these the mineral has been found. When found *in situ*, the ore occurs in bed-like veins up to 10 inches in thickness; in one pit these veins form a network. The junction between the ore and serpentine is usually sharp, but occasionally the passage is gradual. The ore is stated to carry over 50 per cent. of chromium sesquioxide.

In 1907 chrome ore was produced in considerable quantity from the State of Mysore, where it has recently been discovered in the Shimoga, Hassan, and Mysore districts.

The chief locality in the latter district is Kadd Kola where a considerable amount of ore containing from 30 to 52 per cent. of the sesquioxide occurs in a narrow vein which expands, in one place, into a lens-like mass.

At Salem, in the Chalk Hills, Madras, chromite occurs and was worked to a small extent some years ago, about 100 tons in all being exported. The production ceased owing to a fall in price. The chromite-bearing areas consist of intrusive masses of olivine-chromite rock, the mineral occurring in very thin veins and also in lumps in the beds of the neighbouring streams. A vein of chromite 4 to 5 inches wide has been found in the serpentinised olivine at Kanjamallai.

The output in tons from the two chief producing districts of India has been as follows during recent years:—

	1903	1904	1905	1906	1907	1908
	Tons	Tons	Tons	Tons	Tons	Tons
Baluchistan	248	3,496	2,708	4,375	7,274	4,135
Mysore .	—	—	—	—	11,029	610

Ceylon.—Alluvial chromite has been found in the Bambarabotuwa district and in several other localities in Ceylon.

British North Borneo.—A sample from Malliwalli Island examined in the Scientific and Technical Department of the Imperial Institute was found to contain 51·21 per cent. of chromium sesquioxide. A chromite sand also occurs on Marasinsing Beach.

Japan.—Chromite is known to occur in many localities, both in detrital deposits and *in situ* in serpentine. Most of the deposits so far exploited have been of small extent and therefore soon worked out. The most important mine now working is that of Wakamatsu, in the Province of Hoki, where the ore averages 40 per cent. of chromium sesquioxide and is easily worked. On the upper courses of the Mukawa in the province of Iburi, chromite occurs extensively both in serpentine and as gravels. The production during 1907 and 1908 was as follows :—

Province	1907 Tons	1908 Tons
Hoki	1,475	2,004
Bitchu	768	420
Chikuzen	47	20

America.

United States.—Chromite occurs in many localities in the United States, but the deposits are usually not of workable size, or are situated where the cost of freight will not permit of competition with foreign ores. The deposits of commercial importance occur in Pennsylvania, Maryland, North Carolina, Wyoming and California. All the ore produced in 1908 was utilised for furnace linings, none being employed for the manufacture of chrome alloys or salts. Most of the ore was produced in Shasta County, California, a small quantity being obtained from Converse County, Wyoming. The only deposits at present worked in California are those of Shasta County, the more important being on Shot-gun Creek. The ore occurs in a series of 5 lenticular masses, quite close together, ranging from 200 to 1,500 tons, and connected by more or less vein-like stringers. Parallel zones of ore have also been found in the locality, but have not yet been worked. The ore has been found in at least twenty-five other counties in this State. These deposits suffer from the disadvantage of being some considerable distance

from centres of consumption, and as the sailing vessels which formerly carried the ore from San Francisco to ports on the Atlantic no longer run, most of the mines have been closed.

In Converse County, Wyoming, an important deposit has been opened up recently at Deer Creek Canyon, about 15 miles south-west of Glenrock. The ore, which is dense and fine-grained, contains on the average 35 per cent. of chromium sesquioxide, 17 per cent. of ferrous oxide, and occurs in the form of a lens. The ore body has a length of about 600 feet, and a maximum width of 110 feet.

Canada.—As will be seen from the statistics of production given in Part II. of this article (*see next issue*), the output of chromite since 1904 has varied between six and eight thousand tons per annum, most of it being exported to the United States. Practically all the chrome ore produced comes from the Eastern townships in Quebec, where the ore has been worked in Coleraine, Garthby, Wolfestown, and Ireland. The larger proportion comes from the Black Lake district, where most of the producing mines are under the management of one company, whose holdings cover an area of 6,000 acres. The largest producing mine in this district is pit No. 1, situated on the road between Coleraine and Black Lake. The main shaft is on the slope of a gently rising hill, and the ore body on the surface is about 120 feet long and 50 feet wide. At a depth of 80 feet the ore body takes a sudden pitch and largely increases in size. The deposits controlled by this company are said to be well equipped with modern means for concentrating the ore, and much development work is being done.

Near Ireland township, chromite is shown in an open cut near the crest of a hill. The ore occurs disseminated in a band 25 feet long and 8 feet wide. It is stated that 50 tons of ore have been obtained from this pit, and there is reason to believe that a good milling ore could be obtained in quantity. The disseminated ore showed on analysis 23 to 27 per cent. of chromium sesquioxide. The deposit is situated about 2½ miles from Coleraine railway station, but the roads are not in good condition.

In Wolfestown township, chromite has been found in numerous localities, but little is known as to the extent or value of the

deposit. Several cartloads of ore carrying 55 per cent. of chromium sequioxide were obtained from a deposit near Breeches Lake, Garthby township in 1894. The deposit is about nine miles from D'Israeli on the Quebec Central Railway. About two miles from this station is a deposit of considcrable dimensions situated on a hill which was worked to a small extent some years ago. The "dumps" on several pits are stated to show good milling material. Outcrops of ore also occur at South Ham township, but apparently no work has been done on them. A deposit occurs about twelve miles from Robertson station, Leeds township. In 1887 about 54 tons of ore carrying from 51 to 52 per cent. of chromium sesquioxide was produced. Apparently very little work has been done on the deposit since then. A promising deposit is situated about four miles from Eastman station, Bolton township, on the Canadian Pacific Railway. In 1896 about 27 tons of chromite was obtained from this deposit and shipped to Liverpool.

Newfoundland.—Deposits of chromite are known to occur and have been worked at Bluff-Head, Port-au-Port bay on the west coast. The country rock is a diorite traversed by broad belts of dark green serpentine. Several exposures have been worked, and have given ore containing from 39 to 50 per cent. of chromium sesquioxide; one outcrop which is 8 feet wide at the surface has been exposed over a length of 97 feet. The blocks of massive chromite obtained contain small granulated particles of serpentine, distributed throughout the mass, which necessitates dressing the ore in order to obtain a marketable product. During the period 1895–99 about 6,000 tons of ore was exported, mainly to Philadelphia, for use as furnace linings. It has been demonstrated that by suitable dressing the ore will yield 75 per cent. of concentrates carrying 55 per cent., and 25 per cent. of tailings containing less than 25 per cent. of chromium sesquioxide. Several new and extensive deposits have been discovered inland from Port-au-Port bay and on the head waters of Bay D'Est and Gander Rivers. These latter ores are stated to carry a small quantity of platinum.

(*To be continued.*)

GENERAL NOTES.

Appointments.—Mr. J. R. Hill, B.A. (Cantab.), of the Scientific and Technical Department of the Imperial Institute, has been appointed Government Chemist to the Institute of Medical Research at Kuala Lumpur in the Federated Malay States in succession to Mr. B. J. Eaton, formerly an assistant at the Imperial Institute, who has been appointed Agricultural Chemist in the Federated Malay States.

Mr. F. W. Barwick, Mercers' Company's Research Fellow at the Imperial Institute, has been appointed Manager of the Public Testing and Conditioning House of the Belfast Corporation.

Mr. J. S. Coates, B.A. (Cantab.), has been appointed Mineral Surveyor in Ceylon, in connection with the Mineral Survey of the Island, which is being carried on under the supervision of the Director of the Imperial Institute.

The following have been appointed assistants in the Scientific and Technical Department of the Imperial Institute since the commencement of the present year:—

Mr. G. T. Bray, Dr. J. R. Furlong, Ph.D. (Würzburg), and Mr. H. W. Winter.

South African Maize and Kaffir Corn; Season 1910-1911.—Since 1908 arrangements have been in operation at South African ports for the inspection and grading by Government experts of maize for export. The grading regulations for the coming season have now been published, and are as follows:—

Class.	Grade Mark on Bags.	DESCRIPTION.
F.W. 1.	1.	To be sound, dry, plump, and well cleaned, with a maximum together of one per cent. of yellow, discoloured or defective grain.
F.W. 2.	2.	To be sound, dry, and reasonably cleaned, and not containing more than three per cent. of defective grain and five per cent. of other coloured grain.
F.W. 3.	3.	To be sound, dry, and reasonably cleaned, and not containing more than eight per cent. of defective grain and eight per cent. of other coloured grain. Berries may be of irregular size and shape.
F.Y. 1.	4.	To be sound, dry, plump and well cleaned, with a maximum together of one per cent. of white, discoloured or defective grain.
F.Y. 2.	5.	To be sound, dry, and reasonably cleaned, and not containing more than four per cent. of defective grain and five per cent. of other coloured grain. Berries may be of irregular size.
R.W. 1.	6.	To be sound, dry, and well cleaned, with a maximum together of one per cent. of yellow, discoloured or defective grain.
R.W. 2.	7.	To be sound, dry, and reasonably cleaned, and not containing more than four per cent. of defective grain and five per cent. of other coloured grain. Berries may be of irregular size.
R.Y. 1.	8.	To be bright, sound, dry, plump and well cleaned, with a maximum of one per cent. of white or discoloured grain
R.Y. 2.	9.	To be sound, dry, and reasonably cleaned, and not containing more than four per cent. of defective grain and five per cent. of other coloured grain. Berries may be of irregular size.
F.M.	10.	To be sound, dry, and reasonably cleaned, and not containing more than eight per cent. of defective grain.
R.M.	11.	To be sound, dry, and reasonably cleaned, and not containing more than ten per cent. of defective grain.
No Grade.	12.	To include all maize which cannot be classed in a higher grade, but in dry condition and fit for shipment.

In this table F.W. = Flat white, F.Y. = Flat yellow, R.W. = Round white, R.Y. = Round yellow, F.M. = Flat mixed, and R.M. = Round mixed.

Standard samples of this season's maize have been supplied to the Imperial Institute by the Union Government of South Africa and are exhibited in the Public Galleries of the Imperial Institute, where they can be seen by those interested.

It has also been arranged to grade Kaffir corn or Dari which may be shipped from South African ports in the coming season, and the grades of this material are as follows:—

Class.	Grade Mark on Bags.	DESCRIPTION.
White.	K. 1.	To be sound, reasonably clean, and not to contain more than five per cent. of coloured grain.
Pink.	K. 2.	To be sound, reasonably clean, and not to contain more than ten per cent. of white grain.
Mixed.	K. 3	To include any other sweet Kaffir Corn (excluding Jiba or Ghiba) which cannot be classed under red (pink) or white, provided it is sound and reasonably clean.
No Grade.	K. 4.	To include all Kaffir Corn in dry condition fit for export (including smutty) which cannot be classed in a higher grade.

In this case also standard samples of the season's grades have been supplied to the Imperial Institute, and are on exhibition together with the maize samples referred to above.

Camphor Production in German East Africa.—In a recent number of *Der Pflanzer* (1910, 6. 86) some information is given regarding the results of a long series of distillation trials carried out at the Biological Agricultural Institute at Amani with cuttings from the camphor trees grown in that district. The total number of trees available is about 3,500, mostly three and a half years old with a few one year older. These were cut back to the extent of about one-third of their growth. This cutting back produced no ill effects, and at the end of the ensuing rainy season the trees had regained their original size when cut.

The results of the distillation trials are of interest as confirming experience in Ceylon and elsewhere that the leaves are richer in camphor than the wood. In the present experiments young twigs and leaves yielded on the average about 1·2 per cent. of distillate of which 0·8 to 0·9 per cent. was camphor and 0·3 to 0·4 per cent. oil. The latter still retained camphor, which could be recovered in working on a large scale, so that the yield of camphor in these experiments is estimated at 1 per cent. Woody branches, on the contrary, yielded only 0·158 per cent. of distillate consisting of 0·061 per cent. camphor and 0·097 per cent. oil. In growing camphor trees, therefore, it is pointed out that the planter's main object should be to encourage leaf formation. It was found advantageous to carry on the distillation in dry weather as then the raw material was drier to start with and the actual distillation could be carried out more quickly. No certain

difference could be detected in the yield of camphor obtained from leaves and twigs collected from trees grown at different altitudes.

Quebracho Wood.—The quebracho tree occurs in the forests of Argentina and Paraguay, and as its name signifies (*quebrahacho*, axe-breaker) yields a hard tough wood, which is used, though not now so extensively as in former years, for railway sleepers on the Argentina railways. The wood is also a valuable tanning material, and is exported in logs or chips for tanning purposes, and for the manufacture of extract. The manufacture of quebracho extract for export has also in recent years become an important industry in Argentina. The quebracho forests of Argentina are situated in the Chaco territory, and in the provinces of Santiago del Estero, Santa Fé and Corrientes. The Chaco wood is stated to be superior in quality to that from other regions and to contain a higher percentage of tannin. Although quebracho wood by reason of its exceptional hardness can be used for constructional purposes, and, as indicated above, is particularly valuable for railway sleepers, its tanning value is of more importance, on account of the higher price which the wood realises for that purpose. Moreover its use for railway sleepers has been less extensive in recent years, owing to the decreased requirements of the railway companies, who now frequently use metal sleepers. For constructional purposes and for railway sleepers, only trunks of a large size are suitable, but for tanning purposes or for the manufacture of tanning extracts, pieces of any size can be utilised. Comparing the value of the wood for the two purposes it is found that a railway sleeper of quebracho wood is worth about 3½ dollars, whilst the same quantity of wood will furnish tanning extract to the value of 10 or 12 dollars. Most of the companies engaged in working the wood have therefore abandoned the preparation of sleepers and turned their chief attention to the extract industry. The first exportation of quebracho wood was made in 1889 from Santa Fé. From that time the trade has steadily progressed until in the year 1908 the total exports amounted to 254,571 tons, of which 203,065 tons were shipped to the United Kingdom, 11,949 tons to the United States, 8,323 tons to Germany, 7,282 tons to Italy, etc. Colastiné on the Parana river is the principal port of shipment. A large number of companies are now in existence in Argentina for the manufacture of extracts for export. One of the largest of these, it is stated, owns two factories producing 1,000 tons and 600 tons of extract per month, respectively. There are several other factories producing 250 and 300 tons per month. The factories are equipped with modern machinery, stated to be mostly of German manufacture.

The yield of tannin from quebracho wood varies from 25 to 30 per cent. The exports of quebracho extract in 1908 were 48,161 tons, of which 24,936 tons were exported to the United States, 12,518 tons to the United Kingdom, and 4,967 tons to Germany.

The United States and Germany were at first the largest consumers of quebracho extract, but in 1907 the exports to the United Kingdom assumed some importance, and in 1908 they were two and a half times as large as the exports to Germany. This is explained by the imposition of import duties by Germany, which checked the import trade and also affected in some degree the industry in Argentina. There is considerable competition in Argentina amongst those engaged in the quebracho industry, but it is stated that the producers are likely to come to an agreement shortly with the view of controlling the output and maintaining prices. The exploitation of the immense forests of quebracho in the Chaco territory proceeds but slowly owing to the lack of means of communication. The cost of water transport is also high.

The Iron Ore Resources of the World.—The results of an inquiry on this subject made on the initiative of the Committee of the 11th International Geological Congress, Stockholm, 1910, have just been published. A detailed account of the iron deposits throughout the world so far as they are yet known is given. The different portions of the British Empire are dealt with by the following authors:—*Great Britain*, H. Louis; *Canada*, E. Haanel; *Newfoundland*, James P. Howley; *Western Australia*, A. Gibb Maitland; *South Australia*, H. Y. L. Brown; *Queensland*, B. Dunstan; *New South Wales*, Edward F. Pittman; *Victoria*, J. W. Gregory; *Tasmania*, W. H. Twelvetrees; *New Zealand*, James Mackintosh Bell; *British India*, Sir T. H. Holland and F. H. De la Touche; *Rhodesia*, F. P. Mennell; *Transvaal*, G. A. F. Molengraaff; *Cape Colony*, Arthur W. Rogers. The portion dealing with the Crown Colonies, and Protectorates (including British Guiana, Ceylon, Straits Settlements and Federated Malay States, North Borneo and Sarawak, Sierra Leone and Gambia, Gold Coast Colony, Northern and Southern Nigeria, St. Helena, British Somaliland, Uganda, East Africa Protectorate, Nyasaland, Mauritius, and Seychelles) was supplied by the Imperial Institute, and has already appeared in this *Bulletin*, 1909, **7**. 295–308. The section relating to the Anglo-Egyptian Sudan is written by Messrs. Stanley Dunn and C. G. Walter Grabham, whilst that on Egypt is contributed by Dr. W. F. Hume.

Report on the Work of the Imperial Institute, 1909.—This report, giving an account of the work done for the Colonies and India during 1909, has now been presented to Parliament and issued in the Annual Series of Colonial Reports [Cd. 4964-30].

Present Position of Cotton Cultivation.—Professor Dunstan's report on this subject, presented to the recent Brussels Congress of Tropical Agriculture, has now been published by the International Association of Tropical Agriculture and Colonial Development (*see notice on cover*).

RECENT REPORTS FROM AGRICULTURAL AND TECHNICAL DEPARTMENTS IN THE COLONIES AND INDIA.

In this Section of the Bulletin a Summary is given of the chief contents of general interest of Reports and other publications received at the Imperial Institute, from Agricultural and Technical Departments in the Colonies and India.

CYPRUS.

Report on Cyprus Forestry.—A report by Mr. D. E. Hutchins, Chief Conservator of Forests in the East Africa Protectorate, describing the present condition of the forests in the island, the plantations that have been formed under the Forest Department and the steps that should be taken in the near future to conserve and extend the forests.

The demarcated forest of Cyprus covers nearly one-fifth of the island, and consists of about 140,000 acres of good pine (*Pinus halepensis*) and of about 111,000 acres of inferior pine mixed with scrub, while there is nearly 200,000 acres of coast scrub forest, thinly covered with a scrubby growth and a few pine trees. This last class of forest yields much fuel in the form of coppice cuttings. There is also available about 700 square miles of rocky uncultivable land, now used merely for grazing; and it is recommended as a matter of forest policy, that this 700 square miles should be gradually reconverted to forest, so that eventually two-fifths of the whole island would be afforested. The beneficial results in improved climatic conditions, in greater fertility of soil and in the provision of a better supply of timber, as fuel, are detailed, and illustrations of such results accruing from re-afforestation are given from Switzerland, France, Italy, Austria and Germany.

There was much wanton destruction of the forests in Cyprus during the Turkish occupation; and though this was stopped with the advent of the British, very little has been done to repair the damage. Natural regeneration of forests in the island is everywhere feeble, due to the losses of seedlings which take place during the long dry summer; and this slow regeneration is further impeded by forest fires and by the custom of allowing goats to graze in the forest; and it is pointed out that future policy should include more adequate protection from the risk of fire and from destruction of young trees by goats. The principal trees of the island are the Alepo and Laricio pines (*P. halepensis* and *P. laricio*, var. *caramanica*), cedar (*Cedrus libani*, var. *brevifolia*), cypress, (*Cupressus sempervirens*), several oaks, plane, walnut, and as undergrowth, *Quercus alnifolia* and *Arbutus andrachni*. It is considered likely, however, that many species previously found in Cyprus have been

extirpated by drought; and it is suggested that an arboretum should be formed for the purpose of investigating the growth of exotic trees in Cyprus, and that, in addition, experimental plantations of species which do well in similar conditions elsewhere should be tried. A long list of such species is given, and the localities in which they would probably do well in Cyprus are indicated. Sites for plantations are also suggested. The report is copiously illustrated with good reproductions from photographs.

Department of Agriculture, Annual Report for 1909–10.—The work done followed much the same lines as last year (see this *Bulletin*, 1909, 7. 324). The number of plants issued from the seven Government Gardens was 121,936, as against 73,800 supplied in the previous year. The new iron plough introduced by the Department is in small but steady demand. A course of practical instruction in sericiculture was given during the year. The only disease of importance noticed was *Puccinia rubigo-vera* on barley. Experiments with exotic cottons were continued at Nicosia, and the results confirm previous observations that "Sea Island" and "Allen's Long Staple" are suited to the climate of Cyprus, and that "Culpepper's Big Boll" may also be recommended for cultivation.

ANGLO-EGYPTIAN SUDAN.

The following notes on the progress of trade and agriculture in the Sudan have been taken from the monthly reports (April—July 1910) of the Central Economic Board at Khartoum.

The Governor of the Upper Nile Province draws attention to the favourable opportunities for working the talh gum forests in the neighbourhood of Galhak, near Jebel Ahmed Agha. Causeways have been made to enable the produce to be brought down from the mainland over the marshes to the river, and 25 miles of cut road, crossed by native tracks, leads straight into the forests from the Meshra on the Nile. In spite of the favourable conditions, local merchants cannot work this gum district, owing to lack of capital.

Consideration is being given to the possibility of producing a good milling wheat in Dongola and other districts with a view to the establishment at some future time of a milling industry at Port Sudan or elsewhere. There is a very large demand in Egypt and along the Red Sea coast for wheat flour, and the market for flour in the Sudan is also increasing.

The exports of dura during 1909 amounted to 21,999 tons of the value £E136,599, of which 19,847 tons of the value £E128,217 went to Egypt. Sudan dura is gradually establishing itself on the Aden market, to which 3,290 tons were consigned during the first six months of the present year. The export of 1,061 tons to Jeddah is also of interest, as it shows that this trade, which has been suspended since pre-Mahdi times, is becoming re-established. The export of over 2,000 tons of dura to London and Hamburg during the first six months of this year

is the first instance of any export of Sudan dura on a commercial scale to Europe.

The exports of sesamé during the year 1909 amounted to 6,133 tons valued at £E63,066, of which 4,473 tons of the value £E45,944 were sent to Egypt, 817 tons of the value £E8,204 to Austria, and 596 tons of the value £E6,454 to France. In 1908 the total exports were only £25,084 in value.

A new castor seed, which is said to have been introduced from Borgu, West Africa, by Fallatas, is reported from El Obeid in Kordofan Province. The trees of this variety first appeared at El Obeid about two years ago, since when they have increased enormously in number. They are from 6 to 10 feet high, and have seed spikes of a brilliant red colour reaching to 18 inches in length. The trees are finer than the indigenous variety, and produce larger seeds, which, it is expected, will become a profitable article of export when the railway reaches El Obeid

A consignment of 649 lb. of rubber obtained from the wild vine of the Bahr-el-Ghazal (*Landolphia owariensis*, var. *tomentella*) was sold in London on behalf of the Sudan Government in March 1910, and realised prices varying from 3*s*. 6*d*. to 8*s*. 4*d*. per lb., with fine hard Para selling on the same day at 10*s*. 4*d*. per lb. The rubber was prepared by natives under the supervision of an Inspector of the Woods and Forests Department. The cost of transport and marketing of this consignment, including sale expenses, amounted to about 5*d*. per lb.

The quality of the 1910 Tokar cotton crop was favourably criticised by buyers in Egypt. The standard which has been reached is high, and many proofs have been forthcoming of the general interest which this marked improvement has aroused. For next season's crop, 2,000 ardebs of good Egyptian Afifi seed has been purchased by Government for distribution, a quantity which will meet all requirements, so that the sowing of only one quality of seed is assured. The Government is undertaking a small experiment for the improvement of rain-grown cotton in Blue Nile and other Provinces by the distribution of £100 worth of selected seed, which will be given to responsible cultivators. The Governor of the Red Sea Province states that the cotton of 1910 was of good quality and commanded high prices on the Alexandria market. This was largely due to persistent efforts in persuading cultivators to pick and pack the cotton clean. For the first time the cotton brought in for sale was put up in two classes, clean and dirty, and the prices offered varied accordingly. The immediate effect of this classification was that dirty cotton was no longer brought in, and it was soon possible to offer practically the whole as first-class cotton.

A list of the fibre-bearing plants of the Sudan has been prepared by the Director of Woods and Forests and circulated. The list includes the following plants which yield fibres of economic value: *Hibiscus cannabinus*, *Malachra capitata*, *Sida rhombifolia*, *S. cordifolia*, and *Urena lobata*. All these yield bast fibres which are suitable for use as jute

substitutes, and, if properly prepared, would meet with a ready sale in the jute market. The fibres, however, require careful preparation by a process of retting, but, judging from samples of fibres received at the Imperial Institute from the Sudan, the art of retting and extracting fibres does not appear to be known there. In order to create an industry in these fibres it would therefore be necessary first to instruct the natives in good methods of preparation. Other fibre-yielding plants included in the list are: *Sansevieria guineensis*, the fibre of which is being experimentally extracted by machinery at Bor; *Musa* sp., the sheathing petioles of which yield fibre valuable as a substitute for Manila hemp (the extraction of this fibre has to be effected by hand and requires a certain amount of skill); *Eriodendron anfractuosum* and *Calotropis procera*, the flosses of which are of commercial value as stuffing materials for use in upholstery, and *Borassus flabellifer*, which yields palmyra fibre used for brush-making.

Agriculture and Lands Department: Report on milling and baking tests of some Sudan Wheats.—Notes on six wheats grown in the Sudan. The best for milling is a wheat somewhat resembling Muzaffernagar wheat from India. The other five were irregular in type, but one of them, "Debba Dongola," proved to be of good quality and likely to be saleable in the United Kingdom if selected and marketed in a clean condition.

UGANDA.

The Official Report of the British Section of the Uganda-Congo Boundary Commission, 1909, gives the results of the operations of the British Section of the Boundary Commission, which were carried out during 1907–1908. The two sections (British and Belgian) carried out their triangulations independently of each other. Owing to the facts that the British section was accompanied by skilled topographers, and that its members kept in better health than their Belgian colleagues, they were enabled to do more mapping and to check their triangulations by bases and astronomical observations, which the Belgians either did not attempt or did only to a very limited extent. The Belgian Commissioner, after having compared the results obtained by the British and Belgian triangulations, agreed with the Chief British Commissioner as regards the geographical positions of some prominent features in the country near the intersection of the 30th meridian with the Nile-Congo watershed (latitude 1° 8′ north)." The geographical features, native inhabitants, and fauna of the areas visited are all discussed in a series of extracts from the reports of the different members of the Commission. The Commission was accompanied by a geologist, Mr. J. S. Coates, who made geological observations and collected minerals, which were forwarded to the Imperial Institute for examination. Among the industries followed by the natives are mentioned cattle-rearing, basket-work, and canoe-building. A small trade in dried fish and salt is carried on by the natives of Lake Edward, who exchange these for

cereals brought down to market-places by the natives of the uplands. The salt is obtained from Lake Katwe, a small crater-lake containing salt water from which salt of fair quality can be prepared. A small amount of cotton is grown and the natives are being taught to spin it. Rough earthenware is made; and iron is worked in all the hilly parts where ironstone abounds. Copper is worn by the natives in some places, but no evidence was seen of its being worked by them. The geologist reports that recent-looking shallow-water deposits, comprising quartz gravels, sands, and sandy clays with bands of glauconitic sand, layers of ironstone, and some thin seams of lignite, lie in two narrow belts under the escarpments on either side of the Semliki Valley near the south end of Lake Albert. In connection with the geology of the area north-west of Lake Albert, he reports that the country south of Pikoti is formed of biotite-gneiss of a type exceedingly common throughout Eastern Africa, and considered unfavourable to the occurrence of minerals of value. The report is illustrated by plates and maps.

NYASALAND PROTECTORATE.

Agricultural and Forestry Department Annual Report, 1909–10.—A detailed account of the work of this Department during its first year (1908–09) was given in this *Bulletin* (1909, 7. 314), and it is satisfactory to find that the progress then recorded is maintained. The following crops were obtained in 1909. The estimated crops for 1910 are given in brackets for comparison. Cotton, unginned, 852¾ tons (1,735½), coffee 345½ tons (239½), tobacco 550¾ tons (777½), tea 15 tons (32), chillies 44 tons (59), Mauritius hemp 24½ tons (29), Sisal hemp, none (¾ ton), Ceara rubber 448½ lb. (1,385 lb.), other rubber 1,682 lb. (1,738), maize 175 tons (264½), beans, none (37½ tons), ground nuts 7½ tons (161½), wheat 19¾ tons (24½). The only crop which shows a decrease is coffee, which is being replaced by tobacco and cotton. The advice given to avoid low-lying land near the river for Egyptian cotton has been followed (this *Bulletin*, 1910, 8. 217), and in one district 1,000 acres of such land bears this year a good crop of "Nyasaland-Upland" cotton. Selection experiments with Nyasaland-Upland cotton are in progress, and it is pointed out that the ideal plant of this type should have (1) medium height, (2) strong central stem with short internodes, and (3) lateral branches arranged evenly round stem and slightly ascending from it. The lint percentage from the plants from selected seed averaged 28·7 as against 27·0, which is the average yield from unselected Nyasaland-Upland cotton. Experiments are also in hand with various exotic cottons. A scheme for the selection of cotton seed is given in outline. The attention of tobacco planters is called to the desirability of establishing a rotation for this crop, and the rotation:—tobacco, cotton, ground nuts, and a green manure is suggested. The results of experimental tappings of 4-year-old Ceara rubber trees are given, and on the basis of these it is estimated

that the yield per tree for Ceara rubber in Nyasaland cannot be much more than 3 ozs. per annum. Maize was exported for the first time this year, and it is noted that great care should be taken that maize is thoroughly dry before being shipped, in order that it may arrive in good condition. A small supply of soy beans received in 1908 produced a good crop of seed, and from this an excellent crop has been raised this year. It is considered that soy bean will be a very useful crop in Nyasaland as a green manure, for stock feeding, and for the production of beans for export.

RHODESIA.

Department of Agriculture, Southern Rhodesia, Report for 1909.—The exports during the year of agricultural produce included Kaffir corn 1,413,473 lb., maize 2,288,453 lb., and tobacco 190,822 lb. The experimental shipment of 10,000 bags of maize to the United Kingdom was successful, and merchants reported favourably on the condition of the maize and its suitability for manufacturers' requirements in this country. It is, however, recommended that in future consignments more attention should be given to grading, that the bags should be uniform in contents, and that maize should not be exported in a mixed condition.

Agricultural Journal, 1910, 7. No. 5.—Farms and farming in Rhodesia (a description of the Melsetter district)—The Second South African Irrigation Congress (abstracts of Papers read at the Congress)—The conservation of kraal manure—Rubber and coffee in Rhodesia (gives notes on the cultivation of Ceara rubber and coffee in the Melsetter district, and mentions that a sample of coffee grown in this area was recently valued in London at 47*s.* to 48*s.* per cwt.)—Notes from the agricultural laboratories (calls attention to a fodder plant, believed to be a species of *Pennisetum*, obtained from native lands in the Gutu district, and which is suggested as worth trial in other parts of Rhodesia).

TRANSVAAL.

Mines Department, Report on the Manufacture of Iron and Steel in the Transvaal. 1910.—A brief report on the iron-ore resources of the Transvaal. The iron ores of the colony are divided into three main classes, (1) titaniferous ores, (2) magnetic quartzites, and (3) ordinary hæmatites. The titaniferous ores outcrop in the neighbourhood of Onderstepoort. They average from 45 to 47 per cent. of iron, but contain from 13 to 19 per cent. of titanium oxide and are of no commercial value at present. The magnetic quartzites cover a large area, and are well developed near Pretoria and also in the Airlie district; they contain from 45 to 47 per cent. of iron, about 24 per cent. of silica, and a considerable amount of phosphorus. The hæmatite ores are of fairly good quality, but apparently small in amount. Limestone is not abundant and the quality is poor. Doubt exists as to whether suitable coke can be

produced for use on a large scale. The report indicates that the establishment of an iron and steel plant to manufacture rails, wire, etc., would not be successful, but it states that a small electric furnace plant designed to produce high-class steel from the large accumulations of scrap iron in the colony should give excellent results.

The Geology of the Pilgrims' Rest gold-mining district: Geological Survey. 1910. *Memoir No.* 5.—This district is, after the Rand, the most important gold-field of the colony. During 1909 its gold output was valued at over £400,000. The topography, descriptive and economic geology are dealt with in detail in this memoir. Nearly all the reefs occur in the sedimentary formation of the Transvaal system, more especially in the Dolomite and the Black Reef Series. The more important reefs are arranged conformably with the strata and are known as "flat reefs." There is a less important set called "cross reefs," which cut across the beds instead of occupying definite horizons. Both varieties are essentially quartzose in character, and constantly carry metallic sulphides, chiefly pyrites, and occasionally copper ores. It is supposed that the majority of the reefs represent a peculiar form of quartz vein, generally arranged in conformity with the bedding planes of the sedimentary strata, and deposited at certain horizons along which the gold was introduced in soluble form by the circulation of underground waters carrying silica and iron in solution, the gold being precipitated mainly as the result of the reduction of the iron to the ferrous condition. Alluvial gold deposits also occur and are briefly described. The memoir is illustrated by many sections and reproductions of photographs, and is accompanied by a geological map of the district.

The Geology of the Country around Zeerust and Mafeking.—An explanation of sheets Nos. 5 and 6 (Zeerust and Mafeking) of the Transvaal geological map. The area dealt with forms part of the south-western rim of the great Bushveld basin of the Central Transvaal. The chief mineral resources of the area are represented by the Malmani gold-field, and the lead and zinc deposits south of Zeerust. A new feature of the sheets described in this publication is the hill shading, which greatly improves the appearance of the maps, shows up the surface relief, and brings out the close connection between scenery and geological structure.

Agricultural Journal, 1910, 8. No. 32.—Ostrich farming in the Transvaal (a report by the Government Expert on the possibilities of this industry in the Colony, in which it is suggested that an Experimental Farm should be established)—South African Maize and Citrus Conference and Show, 1910—The Principles of Land Settlement—The Valuation of Artificial Manures (gives particulars of the method of valuing manures on the results of their analysis)—Soil surveys—Agricultural lime (describes generally the physical properties of lime suitable for agricultural purposes, and points out that dolomitic or magnesian limestone is generally not suitable for this, especially in

South Africa)—Manurial trials on maize—(these confirm previous observations on the value of superphosphate as a manure for this grain)—Notes from the Chemical Laboratories (gives analyses of bats' guano, old kraal manure, wild "lucerne" (*Merremia palmata*, recommended as a valuable feeding stuff for ostriches), and peanut cake)—Analyses of soils from Zoutpansberg (three analyses are given, all of which show good percentages of "available potash" and phosphoric acid)—The Soy bean (a general article describing the cultivation and uses of the plant)—The poisonous principles of Gift-blaar—*Dendrocalamus strictus* (states that plants of this bamboo have been raised at the Government nursery at Barberton from seeds imported from India)—The "Codling moth" in the Transvaal (describes the life-history of the insect and remedial measures against it)—South Africa show of maize and citrus fruits—Cotton (the second of a series of lectures delivered at the Potchefstroom School of Agriculture) (describes the cultivation of plots side by side, with a view to the selection of the best variety)—The Pasteuriser (describes apparatus for the sterilisation of milk)—Wool and its disposal.

NATAL.

Agricultural Journal, 1910, **14**. No. 4.—Intensive methods in farming—Top working fruit trees—The living bee, Part XXI—Some Wattle insects (describes the "bag-worm," "frog-hopper," and "wattle chafer," all of which attack wattle-trees in Natal)—Citrus export—Experiment Farm Reports. No. 5.—The maize crop in April (the crop was estimated at 645,000 muids as compared with an actual crop of 800,000 muids last year)—Tanning in South Africa and its drawbacks (points out that the principal difficulties in the way of producing good quality leather in South Africa are due to (1) the poor quality of hides obtained from draught cattle, (2) indiscriminate branding, (3) carelessness in flaying and drying the hides)—Botanical analyses of veldt herbage (gives the botanical composition of the plants on virgin land at Winkelspruit and Howick)—Top working of fruit trees—The Bloemfontein Maize Conference (gives minutes of proceedings)—Natal Agricultural Union (proceedings of the annual conference)—Tree planting (recommends more extensive afforestation in South Africa and especially in Natal). 1910, **15**. No. 1.—The maize crops in May (on May 31 the maize crop was estimated at 660,000 muids)—Cotton growing on the Swart Folosi (the cost of production on this area is estimated at £7 2*s.* per acre and the value of the crop at £12 14*s.* per acre. The varieties cultivated are "Caravonica" and "Upland")—Sheep and wool judging—Natal Agricultural Union (proceedings at the annual Conference, continued from the previous number)—Division of Entomology and Horticulture Report for 1909–1910 (gives information regarding the export of various Citrus fruits during the year and of the establishment of a central packing-house in Durban for the sizing, packing and grading of Citrus fruit).

CAPE OF GOOD HOPE.

Report of the Department of Agriculture, 1909.—This publication contains 21 reports made by the heads of the various sections of the Department and a report by the Under-Secretary for Agriculture, which summarises the progress made during the year. The following matters of special interest may be referred to. A table of exports of ostrich feathers for the period 1889–1909 shows an almost steady increase in the quantity marketed and on the whole a general rise in the average value per lb. It appears that the United Kingdom and the United States each take about 31 per cent. of the undressed feathers, France 22, Germany 11, Austro-Hungary 3, and the Netherlands 2 per cent. Inquiries made recently indicate that there is no immediate risk of over-production. The maize exported from Cape ports amounted to 54,737 tons as compared with 4,909 tons in the previous year, and the prices obtained in London ranged from 10*s*. 6*d*. to 9*s*. 1½*d*. in November for "white flat," 9*s*. 10*d*. in May to 8*s*. 11*d*. in August for "yellow round," and 9*s*. 7*d*. in June to 8*s*. 11*d*. in August for "mixed," per 200 lb. bag. There were some complaints of grain being shipped wet, but immediate steps were taken to remedy this, and it is expected that this trouble will be avoided this year. Arrangements have now been made for grading "Kaffir corn" for export (see page 286) Cotton is still being experimented with, but at present it is impossible to say whether farmers will take up this crop. The total area under Turkish tobacco was 70 acres, but as the local market for Turkish tobacco is not large, farmers are being advised to try American leaf in addition to Turkish.

Agricultural Journal, 1910, **36**. No. 5.—The Turkish tobacco industry in Cape Colony (a *résumé* of information concerning the experiments which have been in progress since 1905)—Irrigation development in South Africa with State aid—Results of irrigation, evaporation and dry land experiments in Cape Colony—Agricultural Zoology for South African students—Improving Merino flocks by selection—Co-operative experiments: Cereals (gives reports for the period 1906–09 in trials by farmers of various wheats, barleys and oats. One of the best wheats introduced recently appears to be "Gluyas"). No. 6.—Dried fruit and raisin industry—A South African Botanic Garden (suggests a Botanical Garden for South Africa)—*Argemone mexicana* (describes the weed and suggests means for extermination)—Carbon disulphide for grain insects (describes the best means of applying carbon disulphide as an insecticide)—Manuring wheat in the Humansdorf district—Manurial experiments with oats: Humansdorf district—Agricultural Zoology for South African students—*Cnicus lanceolatus* (describes this weed, commonly known as "Spear thistle," and suggests measures for its extermination)—Co-operative experiments: Grasses—Future Development of Agriculture in South Africa—Farmers' Congress, 1910. 1910, **37**. No. 1.—Eradication of ticks by the starvation method—

Manuring of wheat in the Caledon district—*Plasmopara viticola* (records the extent of the occurrence of vine mildew in the Colony during the past season)—Report of the Government Fruit Inspector for the season 1909–10 (the total quantity of fruit exported amounted to 180,612 cases)—Cattle dipping tanks and how to construct them—Rural Cape Colony (an illustrated description of farms in the Colesberg district)—The manufacture of light natural wines in Cape Colony—Agricultural Zoology for South African students—Pumping tests on boreholes—Co-operative experiments with clovers, vetches, beans, sulla, sainfoin, lupins, and kale.

Sierra Leone.

Report on the Forests and Forestry Problems in Sierra Leone.—Mr. A. H. Unwin, Assistant Conservator of Forests in Southern Nigeria, was deputed in 1908 to examine the forests of Sierra Leone, and this report gives a summary of the results of his inspection and investigations. The first portion deals with the forest in the Peninsular Mountains, which occupies an apparent area of about 48 square miles on the map, but as much of the country is mountainous, the total area covered is rather over 60 square miles. The forest was formerly much larger, but has been reduced by the formation of native ginger farms. It is now recommended that all land above 500 feet elevation should be afforested, which would approximately double the present area. About one-third of the latter is primeval forest, and about one-sixth has been cleared at one time or another, but has now become re-afforested, whilst the residue has been partially worked for timber. The forest is endangered by the work of temporary squatters, who are continually felling trees to clear virgin land for farms, despite regulations against such action. Adequate supervision by forest police is therefore a necessity. Brief descriptions of the principal timber trees occurring in the forest are then given. These include as perhaps the most valuable species, *Lophira procera* (so-called "African oak"), *Mimusops* sp., *Pseudocedrela* sp., *Oldfieldia africana* (true "African oak"), *Chlorophora excelsa* (iroko), *Pterocarpus* sp. (African rosewood), and various Meliaceous trees yielding mahogany substitutes, etc.

The second portion deals with the formation of forest reserves for the supply of timber as fuel, etc., to the Imperial War Department. For this purpose it is suggested that (1) Tail Hill and Sugar Loaf Mountain and (2) 1500 acres of mangrove swamp near Wellington and Allen Town should be reserved, and a scheme for the management of these selected areas is outlined.

The third part of the report deals with the Gola Forest, a beginning of the inspection being made at Susuwuru, which lies in the midst of a belt of copal trees (*Copaifera* sp.). This belt is ten miles long and from half a mile to two miles wide, and in this most of the old trees are dying due to over-tapping, not a single tree of any size having been spared by the natives. It is recommended that this area should be

reserved and its proper management undertaken by the Government. The effect of over-tapping is shown by the fall in export of copal from 5,061 cwts. in 1898 to 930 cwts. in 1907, when high prices would have induced large shipments if the material could have been procured. The area of the Gola Forest proper is about 256 square miles, and of the 98 species found in it, 48 also occur in the Peninsular Forest. A descriptive list of the more important trees is given, including those mentioned above. A notable species is *Cyanothyrus ogea* (the Benin copal tree). The other afforested areas examined included the Kenema Water Reservation, the Panguma and Lorne Mountains, the Blama oil palm belt, etc.

Some forestry work is already done by the Agricultural Department in the Colony, especially in the planting out of copal and rubber trees, but owing to lack of staff but little can be done in this direction. The report concludes with a scheme for the organisation of a Forest Department. In an appendix a very useful list of the indigenous trees of the Colony and Protectorate is given, with botanical names and the English, Timani, Mendi and Benin names of the trees when known. The report is well and profusely illustrated by reproductions from photographs.

INDIA.

Agricultural Departments.

Imperial Agricultural Department, Memoirs, Chemical, Series, 1910, **1**. No. 8.—Water requirements of crops in India (gives the results of a long series of experiments made to ascertain the total minimum quantity of water required by a crop, and the period of growth during which each crop requires most water.

No. 9.—*The Nature of the Colour of Black Cotton Soil.*—The black cotton soil of India covers an area of at least 200,000 square miles and produces the greater part of the Indian cotton crop. An investigation has been carried out with the object of ascertaining the cause of its black colour. The soil cracks to a remarkable degree in dry weather, forming large rents in the ground. The view has been expressed that this cracking is due to the substance which imparts the black colour, and this point, therefore, has also been studied.

Some writers have attributed the colour to organic matter, others to the presence of graphite or of organic salts of iron, whilst the curious idea has also been put forward that the colour is due to the presence of a plant which excretes a black dye from its roots.

The results of the work have shown that the black colour is chiefly due to the presence of several per cent. of titaniferous magnetite and 1 to 2 per cent. of soluble humus. The cracking of the soils is due to the large proportion of clay which they contain. The soils are not rich in organic matter and appear to be much improved by the application of organic nitrogenous manures.

Botanical Series, 1910, 2. No. 9.—The Wilt disease of pigeon pea and the parasitism of *Neocosmospora vasinfecta*, Smith. 1910, 3. No. 1.—Studies in Indian tobaccos. I. The types of *Nicotiana rustica*, L. Yellow flowered tobacco. (The Indian types fall naturally into two groups: (1) tall plants with open habit and long internodes, and (2) short, bushy plants. Group (1) includes five types, whilst group (2) is divided into three classes depending on the nature of the inflorescence, and includes altogether fifteen types. A detailed illustrated description of each type is given.) II. The types of *Nicotiana tabacum*, L. (The authors recognise fifty-one Indian types of this species, which is the only species cultivated in the peninsula, where, as in other countries, it forms the most important source of commercial tobacco. The characters selected as a basis of a provisional scheme of classification are habit, shape of leaf, and similarity or dissimilarity of the inflorescence and lower leaves. In this way two main classes are obtained, the first having petiolate and the second sessile leaves. The first class includes two sub-classes, the one having ovate and the other sub-cordate leaves. The second class includes three sub-classes, (*a*) having linear or lanceolate leaves, (*b*) having somewhat broader leaves, and (*c*) having wide elliptical leaves. A detailed description of each type included in these various sub-classes is given, with illustrations showing the habit of the plant, and the characters of its leaf, flower and capsule.) No. 4.—The influence of the environment on the milling and baking qualities of wheat in India. (This memoir gives the results of an investigation into the change in character and quality of wheat when grown in different districts. For this purpose Muzaffarnagar wheat was grown at three different stations in 1907, and at nine different stations in 1908. The wheats thus obtained were submitted to milling and baking trials by Mr. A. E. Humphries in England and showed very different characteristics, the flour "strength" varying from 52 to 75 and the "stability" from 64 to 84, and it was estimated that there was a difference of several shillings per quarter in value between the best and worst of the samples. In a previous memoir (this *Bulletin*, 1909, 7. 419) reference was made to the classification of the Punjab wheats. The twenty-five types distinguished in this group were grown in 1908 at Cawnpore, and the crops obtained were compared as regards consistency of grain, percentage of nitrogen, and weight of 1,000 seeds with those of the original wheats grown at Lyallpur, and in many of these cases also the three characters mentioned show considerable variation as the result of change in place of cultivation. The investigation is being extended to other Indian wheats, and particularly to three selected wheats recently produced at the Pusa Research Institute.

Report of the Agricultural Research Institute and College, Pusa (including Report of the Imperial Cotton Specialist), 1907–09.—The Pusa Institute has an estate of 1,300 acres of deep alluvial land which is capable of growing nearly every rain-crop which can be grown in the Indian plains. It is situated in the midst of a region of intensive culti-

vation, which is controlled by a community of indigo planters. The present publication contains the Reports for the years 1907–09 and the Programmes for the year 1909–10 of the Director of the Institute and the various officers associated with him.

The Imperial Agriculturist has conducted manurial, rotation, and pasture experiments, and efforts are being made to obtain and acclimatise the best indigenous and exotic varieties of wheat, barley, oats, maize, rice, various pulses, oil-seeds, sugar-cane, jute, flax and tobacco. Attention has also been given to the breeding and rearing of cattle, sheep and poultry.

The most important work done by the Imperial Economic Botanist during the period under review has been a botanical survey of the wheats of India. Several promising wheats have been isolated by selection and are now being tested (see p. 301). Hybridisation experiments are being carried out with the object of improving the grain, the straw, and the resistance to rust of the Indian wheats, and an inquiry is being made into the influence of soil, climate and moisture on the character of the grain. Much work has been done in connection with fruit culture, and experiments have been carried out with flax, *Hibiscus cannabinus*, *Crotalaria juncea* and Sisal hemp.

The Imperial Agricultural Chemist is conducting an investigation on the effect of soil and manure on the composition of certain seeds, and is co-operating with the Imperial Entomologist in a study of the means of preventing injury by weevils to wheat and other grain when stored in bulk. An inquiry is also being made as to the cause of the colour of the black cotton soil (see p. 300).

The Imperial Mycologist is studying the Wilt diseases of cotton, indigo, pigeon pea and gram, and experiments to obtain a strain of pigeon pea resistant to the disease are giving very promising results (see p. 301). Attention has also been given to the red-rot disease of the sugar-cane, the disease of the palms of the Godavari Delta, the coconut palm disease of Travancore, and the diseases of mulberry and other fruit trees in Kashmir.

The Imperial Entomologists have directed their attention to the various insect pests of India, have made experiments on "Eri" silk culture, the cultivation of lac, and other problems. An experiment in apiculture has been started with a view to ascertain whether European bees will thrive in the Indian plains. A comprehensive investigation is in progress on the various flies which attack fruit in India.

The Imperial Cotton Specialist is endeavouring to effect the improvement of Indian cotton by (1) selection and distribution of seed, (2) the introduction of superior indigenous varieties and better cultural methods, (3) hybridisation, and (4) trials with exotic varieties. Useful and interesting results have already been obtained.

Agricultural Research Institute, Pusa. Bulletin No. 16. 1910. *Second Report on the Fruit Experiments at Pusa.*—An account is given of experiments on fruit growing in the plains of India which were com-

menced in 1905, including a description of the soil and climate of Pusa, and the methods employed in planting, irrigating and cultivating. Of the various fruit trees cultivated, peach trees have made the most rapid growth and have been the first to bear fruit. The varieties under experiment are all Indian kinds, but the fruit produced has been far superior in both yield and quality to that ordinarily grown in the Indian plains. The methods of treating the crop and of gathering and packing the fruit are fully described.

Agricultural Journal, 1910, 5. Part 2.—The furlough wanderings of a Director of Agriculture (describes the experimental farm of the West of Scotland Agricultural College, near Kilmarnock)—Agricultural improvements in Chhattisgarh—The outbreak of "blister blight" on tea in the Darjeeling district in 1908-09—A new insecticide (suggests lead chromate as a substitute for lead arsenate)—Cattle-breeding in Sind—The stem-borer of Sesamum—Entomological Notes (deals, *inter alia*, with "Eri" silkworm, Deccan grasshopper and a new indigo pest (*Ypsolophus ochrophanes*, Meyr.)—A promising weed (*Melilotus alba* is being recommended as a fodder plant and as a green manure). Part 3.—The edible mushroom, *Agaricus campestris*—Hairy caterpillars in the South Arcot district, Madras (describes the life-histories of two species which attack *Pennisetum typhoideum* and ground-nut)—School gardens—*Andropogon sorghum*, its cultivation and some of its enemies—Management of experimental stations in India—Agriculture at the Lahore Exhibition (gives illustrated descriptions of some of the exhibits, particularly fibres, wheats, and cottons)—Jute in rotation with paddy in the same year and its effect on food-crops—Bleaching of ginger (describes the curing and bleaching of ginger as practised in Travancore)—Caravonica cotton (gives a *résumé* of recent information regarding the cultivation of this tree cotton, and concludes that "the tree cotton which will succeed as a field crop has still to be discovered")—The cultivation of the banana in Travancore—Experiments on the availability of nitrogen in peat, peat-moss and elephant dung as compared with certain other manures (it is considered that these three materials are about equal in value to cattle manure judging from the yields of dry matter and percentage of nitrogen obtained from plants grown on them, but all are inferior to castor-cake)—Urine earth as a manure—Some aspects of agricultural work in the Chenab Colony—Eri silk cultivation in Coorg—A method of seed-testing in use among cultivators in the Broach district, Bombay—The effect of partial sterilisation of soil on the production of plant food.

BENGAL.—*Report of the Agricultural Department*, 1908-09.—Experiments with jute have been continued at Burdwan, and have proved that if Naraingunge seed is sown and care is taken in cultivating and retting, the local cultivators can obtain fibre of a quality equal to that produced in Eastern Bengal. Jute-growing trials have also been carried out at Cuttack, Purnea, Berhampore, Frasergunge, and other localities. The acclimatised Upland Georgian cotton, known as "Buri Kapas," has been

cultivated on the Chiabassa Farm, but, owing partly to the drought, unsatisfactory results have been obtained. Flax experiments have been continued at Dooria, in the Muzaffarpur district, and the results show that on an area of 20 acres a net profit of about £7 10*s.* per acre was obtained. At Bhagalpur an investigation is being made of the sugar-yielding capacity of the Bengal canes, specimens of the different varieties having been collected for the purpose from each Division. It is intended to test the possibility of obtaining improved varieties by a system of chemical selection. An effort is being made to improve the silk industry of Bengal, and a central nursery has been established at Berhampore. Five model nurseries have been opened, making a total of fourteen now in operation. The work is being extended into the Midnapore and Birbhum districts. Experiments are being made with Italian and Japanese mulberry seed, and favourable results have so far been secured. A brief account of the work of the Agricultural Stations is given in an appendix, but a full report of each is published separately (see below).

Bankipore Agricultural Station, 1908–09.—The season was very unfavourable on account of the drought. The most important work of this station was the construction of a silo with a capacity of about 130 tons, by means of which it is now possible to ensure a supply of fodder in times of famine. The silo was filled with green "juar" (sorghum) in September and October, 1908, and was afterwards closed. It was opened on April 1, 1909, and gave a supply of wholesome fodder throughout the hot, dry season of 1909. The bullocks ate the fodder eagerly and remained in excellent condition. The mango crop of Bihar was a failure, but at the Bankipore Station an excellent crop was obtained owing to care in cultivating and irrigating the trees.

Burdwan Agricultural Station, 1908–09.—Experiments have been carried out with jute, rice, and potatoes, the greater part of the work being devoted to the jute crop. It has been found that the Burdwan district can produce a fibre equal to good Narainganj jute and much superior to the ordinary jute of the Burdwan, Presidency, and Orissa Divisions, which is weak and soft. The experiments have also demonstrated that jute in rotation with rice or potatoes is well suited to the Burdwan district, both a fibre crop and food crop being obtainable from the same land in one year. Manuring with bone-meal and saltpetre gave good results with rice, whilst castor-cake has been found an economical manure for potatoes.

Cuttack Agricultural Station, 1908–09.—Experiments on jute cultivation have shown that jute of a quality equal to the best Narainganj fibre can be grown in Orissa, and that the jute plant can be grown in rotation with either rice or potatoes in one year. Trials with the Meston plough have shown that it is very suitable for rice cultivation. The fine "aus" rice of the Central Provinces has been found to be well adapted for growth in Orissa. The "khari" variety of sugar-cane from Lower Bengal and the "mango" variety from Shahabad have

proved to be suited to the same district. Ground-nuts of the ordinary commercial Calcutta variety grow exceedingly well in Orissa, and yield about 1,600 lb. of unshelled nuts per acre.

Dumraon Agricultural Station, 1908–09.—The work of this Station is chiefly devoted to the sugar-cane, but rice, mustard, oats and wheat are also receiving attention. The experiments carried out during 1908–09 suffered greatly from the drought and every crop required artificial irrigation. With regard to the sugar-cane, it has been found that of the numerous Bengal varieties "khari" is the best, and that cow-dung and castor-cake as a manure and the trench system of planting are superior to the local practices of manuring and planting. The local varieties of rice compare favourably with any other varieties. The Raipur and Jabbalpur varieties of mustard have proved more prolific than the local Shahabad variety. Dumraon oats and the white variety of Muzaffarnagar wheat have given excellent results.

Quarterly Journal, 1910, **3**. No. 4.—Tasar silk in Singhbhum—Cultivation of "Sabai" grass in Sahebganj—Tests with four nitrogenous manures (the results indicate that calcium cyanamide and calcium nitrate are not inferior in value to sodium nitrate and ammonium sulphate)—Betel leaf insect—Sugar in the British East Indies—Some useful products of the *Nim* tree—Improvement of fisheries in Bengal.

EASTERN BENGAL AND ASSAM.—*Bulletin* No. **18**.—Note on Jhum Cultivation near Lumding ("Jhum" is the term applied to the temporary fields produced by cutting down and burning forest or jungle. As a rule the "jhum" is cultivated for two years and then abandoned, since at the end of that time it becomes difficult to keep down a species of couch grass. A description of the method of preparing the ground and a list of the usual crops are given). No. **19**.—Bordeaux mixture as a preventive of potato disease (spraying with Bordeaux mixture is recommended for the control of the "black disease" or "pang-iong," which affects potatoes in the Khasia Hills. Directions for the preparation of a suitable mixture are given). No. **20**.—Coffee cultivation in the Khasia Hills (*Coffea arabica* was introduced into the Khasia Hills thirty years ago, but it is only within the last ten years that the crop has attracted the attention of the native cultivator, and the total production is still very small. The methods of planting and preparing the coffee, which are rather primitive, are described. An experimental plot has been formed at Wahjain Farm, with the object of introducing improved methods).

MADRAS.—*Central Agricultural Committee. Bulletin* No. **7**.—*Rats infesting Coconut Palms*.—Rats cause a great amount of damage in coconut plantations by attacking not only the mature nuts, but also the tender leaves. They make their nests in the fibrous network at the base of the leaves. An account is given of various methods of trapping the rats as well as of other means of preventing their ravages.

BURMA.—*Report of the Department of Agriculture, Burma*, 1908–09. —The cultivation of moisture-resisting varieties of Moulmein rice in the Akyab district has been very successful. These varieties are becoming firmly established, and are proving very popular. An important development has taken place in the cultivation of wheat in the Chin Hills, and it was anticipated that the crop for the year under review would amount to 200,000 lb. as against 75,000 lb. in the preceding year. In view of this extension, the Agricultural Department have devoted considerable attention to the crop and have made recommendations to growers with regard to rotations, watering, manuring and allied matters. The cultivation of ground-nuts is increasing rapidly, the area planted in 1908–09 being double that of 1907–08. The soil and climate of Lower Burma do not appear to be suitable for cotton cultivation. Experiments with various American and Egyptian varieties on a small scale were not successful. Virginia and Havana tobacco seed was distributed in twenty districts for experimental cultivation, but the results were generally discouraging. Sunn hemp and jute have been grown with varying success.

Forest Departments.

Indian Forest Memoirs. Economic Products Series, 1910, **2**. Part 1. *The Prospects of the match industry in the Indian Empire, with particulars of proposed match-factory sites and woods suitable for match manufacture.*—In 1907–08 about 11,803,000 gross of boxes of matches were imported into India, whereas only about 700,000 gross per annum are being manufactured in the country. The question has therefore arisen as to whether it would not be possible to manufacture in India itself all the matches required there. As a result of a study of this question it is affirmed that India is quite capable of supplying its own requirements, and that the match industry offers excellent prospects provided that it is developed on proper lines. The most important requisites are that (1) proper sites should be procured; (2) sufficient capital should be expended on good machinery; and (3) good management should be provided. The object of the present memoir is to point out the difficulties which have hitherto prevented the successful development of the match industry in India and to explain the manner in which they can be overcome. After discussing the position of India with regard to match-manufacturing and indicating the advantages and disadvantages which it possesses, an account is given of the methods of manufacture, the materials employed, and the requirements of factories, together with estimates of working expenses and profits obtainable. The character of the wood employed for matches and the treatment to which it is subjected are fully dealt with, and suggestions are made with regard to suitable sites for match-factories in the various provinces of India.

Forest Pamphlet, No. 16. *Botany Series*, No. 1. *Note on Best*

Season for Coppice Fellings of Teak (Tectona grandis).—In many parts of India the period preferred for felling timber is the latter part of the rainy season, namely, from the middle of August until October. This is partly due to the fact that at this time agricultural activity is at a minimum and labour is therefore easily obtainable, and partly also to a belief that wood cut during the rainy season is more durable than that cut at other times.

About the year 1898 the question arose as to the advisability of prohibiting all fellings during the rains, since this season is the period of maximum vegetative activity, and it was considered probable that felling at this time must be highly detrimental to coppice reproduction. The forest officers in the Central Provinces devoted attention to the subject, and several experimental coppice plots were established with the object of obtaining trustworthy data as to the amount of injury caused to coppice reproduction by cutting back at certain seasons. The present pamphlet gives an account of the results obtained in some of these experiments, together with suggestions for future work which, if adopted, would tend to uniformity of procedure and would facilitate comparison of the results. The indications so far obtained are that the worst period for felling teak is from the time that vegetative activity commences until, and for a short time after, the foliage has fully developed, and that the best seasons for the purpose are immediately before and after this period, that is, in March and September.

Indian Forest Records, 1910, Vol. 2, Part 2. *A Note on the Fissibility of some Indian Woods.*—An account of an investigation of the fissibility or splitting capacity of sixty-one species of Indian woods. It is pointed out that the property of fissibility is closely related to the economic value of a wood, *e.g.* ready fissibility is of advantage for split fuel, but is undesirable for wood which is to be used for any purpose involving its exposure to considerable strain. Moreover, the manner in which a timber splits is very frequently of great importance, and especially with reference to the straightness of the grain and the evenness of the split surface. A description is given of the method and apparatus employed in carrying out the tests, and the results are tabulated in an appendix. The various factors affecting the fissibility of wood are discussed, particular consideration being given to the anatomical structure, hardness, the relative effects of radial and tangential cleavage, and the amount of moisture present. The character of the surface produced by splitting is noted in each case and illustrated by means of plates. It has been found that the tangential surface of fission is usually smoother and straighter than the radial surface, and particularly so in the case of cross-grained woods.

EASTERN BENGAL AND ASSAM.—*Progress Report of Forest Administration*, 1908–1909.—The total area of State Forests on June 30, 1909, amounted to 29,024 square miles and consisted of 6,317 square miles of reserved forests, 4 square miles of protected forests, and 22,703 square miles of unclassed forests. The total out-turn of timber

during the year amounted to 6,485,701 cubic feet, and that of fuel to 11,811,195 cubic feet. The minor forest produce collected included 11,884,747 bamboos and 10,640 lb. of rubber. In the Charduar Rubber Plantation, Darrang Division, 419 acres were worked and 4,734 trees were tapped, which yielded 7,560 lb. of rubber or 18·1 lb. per acre. In the Kulsi Plantation, Kamrup, 66 acres were worked, 3,953 trees were tapped, and a total yield of 2,573 lb. of rubber was obtained, or 39 lb. per acre. An attempt is being made to grow *Ficus elastica* in the Lushai Hills. During the year 50,000 seedlings were raised and 16,449 were planted out, and considerable success has been attained. Arrangements have been made with the Lushai Chief for the cultivation of rubber trees by the villagers. The experimental cultivation of Ceara rubber (*Manihot Glaziovii*) has been commenced in Cachar. Experiments have been made on the propagation of lac on "arhar" (*Cajanus indicus*) in several Divisions, but so far without success.

BENGAL.—*Annual Progress Report on Forest Administration in the Lower Provinces*, 1908–09.—The total forest areas on June 30, 1909, were 4,240 square miles of reserved forests and 3,380 square miles of protected forests. The total out-turn of timber amounted to 5,473,431 cubic feet, and that of fuel to 31,861,740 cubic feet. It has been found that "sal" (*Shorea robusta*) can be regenerated naturally under the conditions prevalent in most of the forests of the Bengal Forest Circle, and it is therefore unnecessary to have recourse to artificial reproduction. The aid given by cleanings has proved very successful, and during the year under report such operations were carried out over 2,599 acres. Experimental trials of *Catalpa speciosa* seed were made in the Darjeeling, Kurseong and Tista Divisions, but without success.

BOMBAY, INCLUDING SIND.—*Administration Report of the Forest Circles*, 1908–09.—The total forest area on June 30, 1909, amounted to 15,103 square miles. The yield of timber was 5,189,450 cubic feet, and that of fuel 33,479,042 cubic feet. The number of bamboos collected amounted to 10,066,115. The work of removing prickly pear from the forests in the Central Circle has been continued, and no less than 787,544 cubic feet of the pest have been eradicated. A heavy mortality has occurred among the sandalwood trees of South Kanara, and is regarded as possibly due to the "spike" disease which occurs in Mysore. In the report for 1907–08 (this *Bulletin*, 1909, **7**. 331), it was stated that Lantana is of value as a host to sandalwood trees. In many parts of the Southern Circle, however, the plant has spread to such an extent as to be causing injury in the coppice fellings, and efforts are therefore being made to check it. The rubber plantation at Mulund, South Thana Division, has been extended, and a new plantation has been started at Shahapur. The Pelhar rubber plantation in the Central Thana Division has been enlarged. Good results with rubber trees have been obtained in the Gersappa plantation in Kanara. From the

results so far obtained, it is considered by the Curator of Government Gardens and Parks, Nilgiris, that Para and Ceara rubber could be grown with success and profit in certain parts of Kanara, but that in Thana, although there is some promise of success, the plants would grow more slowly. On the other hand, the Conservator of Forests, Southern Circle, is of opinion that the Kanara climate is unsuitable for rubber, except perhaps for the more hardy Ceara.

BURMA.—*Reports on Forest Administration*, 1908–09 (*with Government of India Review*).—The total area of reserved forests at the close of the year was 23,581 square miles, and the estimated area of unclassed forests was 110,868 square miles. The number of teak trees girdled was 122,604, and the quantity of teak obtained amounted to 270,140 tons. Of other timbers, 317,394 tons were collected, as well as 276,589 tons of fuel. No proposals were received during the year for starting a factory for the manufacture of paper-pulp from bamboo, but an application was made for 20 tons of bamboo chips to be shipped to Norway for experimental conversion into pulp; it was found, however, that the cost of extraction and freight would be about £200, and the matter was therefore not proceeded with. The Para rubber trees in the Mergui plantation yielded 3,081 lb. of dry rubber during the year. The tannin factory at Rangoon remained closed throughout 1908–09, but is now to be placed at the disposal of the Forest Chemist for the manufacture of decolorised mangrove extracts on a commercial scale. A quantity of seed of *Pterocarpus dalbergoides* from the Andamans was sown experimentally, and, although it germinated satisfactorily, the plants did not grow well, owing partly to damage by insects; it is probable that Upper Burma is too far north for this species. Trials with *Catalpa speciosa* did not result in such vigorous growth as was anticipated.

COORG.—*Progress Report of Forest Administration*, 1908–09.—The area of reserved forests on June 30, 1909, amounted to 333,105 acres, or about 520 square miles. The total out-turn of timber was 232,861 cubic feet, including 9,350 cubic feet of sandalwood, whilst the fuel collected amounted to 68,770 cubic feet. Considerable difficulty is being experienced with regard to the propagation of sandal trees. Dibbling experiments have failed, and the number of trees grown in the plantations is more than counterbalanced by the uprooting of trees affected with "spike" disease. It has therefore been decided to encourage the ryots to grow sandal trees, and small rewards are being offered for plants which have attained a certain height.

Geological Survey.

Memoirs, 1910, 38.—Gives a full account, illustrated by photographs and maps, of the phenomena recorded in India in connection with the Kangra earthquake of April 4, 1905, which had epicentra at Kangra and Kulu, in the outer Himalayan hills of the Punjab and North-Western Provinces. The earthquake is attributed to the sudden release of strains among the sub-Himalayan formations.

Records, 1909, **38**. Part 4.—Three papers relating to marine tertiary beds in Burma, including the Sitsayan shales, Lower Prome Series (with fossil fish) and Upper Prome Series. All are considered to be of Oligocene age. They are followed by a great thickness of Kama clays, which are believed to range from the Burdigalian to Pontian—that is to say, from the base of the Lower Miocene to the Upper Miocene The Oligocene and Miocene beds are all included in the Pegu system. They are overlaid unconformably by sandstones which pass uniformly up into the Irrawaddy system. Noetling's classification is abandoned. Oil seepings proceed from the Kama clays of Western Prome and Kama, but the prospects are not considered to be promising. The iron ores (mainly hæmatite) of Chanda, Central Provinces, are described. Some of them are smelted locally. Notes are furnished of the geology of the Aden Hinterland. The sedimentary rocks consist of a carbonaceous limestone shown by the fossils to be probably of Upper Jurassic age. This is covered by a sandstone at least 2,000 feet thick, succeeded by volcanic rocks including rhyolite lava and ash, and basic lava resembling the Deccan Trap and believed to be contemporaneous. The occurrence of samarskite, a mineral containing tantalum, iron, uranium and the rare earth metals, in the Sankara mica mine, Gridalur, Nellore district in the Madras Presidency, is recorded.

Miscellaneous.

Annual Report of the Board of Scientific Advice for India, 1908–09.—This Report contains (1) summaries of the proceedings of meetings of the Board in May 1909 and January 1910; (2) annual reports on industrial and agricultural chemistry, forest chemistry, astronomy (solar physics), meteorology, terrestrial magnetism, geology, geodesy, geography, botany (botanical survey, economic botany, mycology and forest botany), forestry (sylviculture and forest products), zoology (zoological survey, agricultural entomology and forest entomology), and veterinary science; (3) programmes of work of the various scientific departments for 1909–10, and (4) an appendix, indicating the economic investigations conducted for the Government of India at the Imperial Institute during the year ending September 30, 1909. Most of the work recorded in this Report has already been published in detail in the various departmental publications, a list of which is appended to the Report.

Agricultural Ledger, 1908, **9**. No. 7.—*Crotalaria juncea* (gives a report on the cultivation of this fibrous plant (san hemp) in the Pabna district with valuations of the fibre and the results of its chemical examination and valuation at the Imperial Institute) (compare this *Bulletin*, 1910, **8**. 121).

Indian Trade Journal, 1910, **17**. No. 217.—Agricultural implements for Burma (the principal difficulties in the way of introducing European implements into Burma are stated to be (1) their great weight, (2) their complicated structure, and (3) their high cost. The principal machines

needed are (1) light reapers, (2) threshers for hand or bullock power, (3) winnowers, (4) seed drills of simple pattern, (5) drill harrows and (6) ground-nut harvesters).

No. 219.—India and the wheat supply.—The synthetic production of ammonia.—No. 220.—Indo-Chinese Trade (deals more particularly with the resources of Western Yunnan)—Report of the Wheat Elevator Committee—Summary of climatic conditions in India in 1909–10—The Indian match industry, 1910, 18. No. 226.—Agricultural implements for the Central Provinces and Berar (gives a descriptive list of the chief agricultural implements needed by natives).

CEYLON.

Royal Botanic Gardens. Report for 1909.—The Entomologist reports that the "Shot hole borer" (*Xyleborus fornicatus*) continues to slowly extend its range in tea plantations and is causing a diminution in yield on estates established on poor soils. The destruction by fire of all prunings is an important factor in the control of this pest. The introduction of the beetle (*Clerus formicatus*) predatory on this pest has been unavoidably delayed. During the last two years "green bug" (*Lecanium viride*), formerly a serious pest in coffee plantations in Ceylon, has become a somewhat serious pest in tea gardens in the Haputale district. The burning of prunings and the spraying of the pruned bushes with kerosene emulsion or a soap insecticide are recommended. *Hevea brasiliensis* continues to remain practically immune from insect attack, though slugs (*Mariaella dussumieri*) have caused damage to rubber plants on one estate in the Kelani Valley. "Vaporite" is suggested as a remedy, and also the protection of the stems by freshly-tarred paper. The silk farm at Peradeniya Junction is being re-opened as a private enterprise, and for the present it is proposed to rely on India for a market for Eri silk cocoons. The Mycologist reports that owing to the prevalence of "blister blight" (*Exobasidium vexans*) on tea in India arrangements have been made to disinfect all tea seed received from that country with dilute mercuric chloride solution. Circulars issued during the year relating to various fungoid diseases have been noticed already in this *Bulletin* (1909, 7. 333, this vol. pp. 78 and 203). The Chemist mentions that the experiments with various crops at the Peradeniya Experiment Station were continued. Manured cocoa showed increased vigour, and a general improvement in foliage over unmanured. Fermentation experiments with cocoa showed that the dark purple colour of the beans of some "Forastero" varieties could be changed to a red, which dried to brown if the beans could be kept acid, and experiments are now being made with fermentation liquors of increased acidity. On the whole the best results were got by fermenting twenty-four hours, partially washing, fermenting

again for twelve hours, again lightly washing and then drying in the sun. The effect of mulching on cocoa soils is also being investigated. Trials with the new Manihots, *M. dichotoma*, *heptaphylla* and *piauhyensis* have not given good results so far, but at the Maha Illuppalama Gardens the first of these is said to be doing well. An experiment with Egyptian cotton at the latter gardens was not altogether a success. Twenty acres were sown at the end of February; growth was unsatisfactory, most of the plants being tall and thin in habit, reaching 6 feet or 7 feet in height with bolls only on the upper part of the plant. The flowering was very uneven. The returns of seed cotton per acre were as follows: Mitafifi 185 lb., Ashmouni 93 lb. and Yannovitch 93 lb., the yield of lint from this seed cotton being from 32·5 to 34·0 per cent. The Director of Agriculture in Nyasaland has suggested that the poor results were probably due to over-watering, and has made suggestions as to the course to be followed next year.

Circulars and Agricultural Journal, 1910, 5. No. 1.—The tea-plots at the Experimental Station, Peradeniya (describes the varieties grown, the soil, the methods of treatment and manuring, etc., and the effect of manuring on the composition of the soil. The results obtained thus far indicate that green manuring with *Erythrina* spp. and with *Crotalaria* spp. gives good results even without other manures). No. 2.—Rubber in the early days, I. No. 3.—Rubber in the early days, II. These numbers are summaries of "circulars" issued in Ceylon in 1898 and 1899 on Para rubber cultivation. No. 4.—Describes a visit paid by the Director of the Royal Botanic Gardens to a rubber factory in Germany. In the course of the description it is pointed out that it is advantageous to the manufacturer to receive rubber in blocks not more than an inch thick, and that the chests in which plantation rubber is packed should be planed smooth inside and lined with paper in order to avoid chips of wood, sawdust, etc., becoming detached from the inside of the cases and adhering to the rubber. No. 5.—School gardening and nature study. No. 6.—Brown root disease (a description of this disease, *Hymenochæte noxia*, is given: it attacks Hevea, cocoa, tea, dadap, Castilloa, cassia, camphor, coca, and other plants. It is pointed out that as a rule the fungus does not travel through the soil except in contact with roots or dead wood, and consequently trees attacked by the disease should be removed with as much of the roots as possible and burnt).

Tropical Agriculturist, 1910, 34. No. 5.—Progress in Ceylon agriculture. Literature of economic botany and agriculture (this section relates to olives, opuntia, palmyra, pandanus, paper, pepper, pineapples, plantains, etc.)—Ceylon Agricultural Society; Progress Report XIX. No. 6.—Chena, jhuming, taungya or ladang (a discussion of some of the evil effects of the native method of cultivation)—Nitro-bacterine—Literature of economic botany and agriculture (this section deals with rafia, resins, rhea, rice, etc.). Ceylon Agricultural Society Report for 1909–10.

1910, 35, No. 1.—Agriculture in the United States of America and Canada.—Entomological Notes (a series of short notes on "green bug," a new coccid pest of Castilloa rubber and a caterpillar pest of *Erythoxylon Coca*).—Ceylon Agricultural Society. Minutes of the Annual General Meeting held on June 8, 1910.

STRAITS SETTLEMENTS AND FEDERATED MALAY STATES.

Agricultural Bulletin, 1910, 9. No. 5.—Coconut palm disease (describes a disease which has broken out in Borneo, and which appears to be very similar to that usually known as "bud-rot").—Timber notes (describes the timbers of *Carapa moluccana*, *Carallia integerrima*, *Sindora Wallichi* var. *Siamensis*, Balau (*Shorea* sp.), *Shorea collina*, and *S. materialis* with notes on the classification of the *Shorea* spp.). No. 6.—Historical notes on the rubber industry (details the part taken by the Singapore Botanic Gardens in the rediscovery of "wound response" in rubber trees, the preparation of Para rubber in biscuit form, and generally in the development of the rubber industry in the East).—Coconuts in peat soil.—Para rubber fungus (a fungus found on dead trunks of Para rubber trees in the Singapore Gardens has proved on examination at Kew to be a new species of *Eutypa*).—Effect of sodium nitrate on the flow of Ceara latex. No. 7.—Experimental tapping of Para rubber trees in the Botanic Gardens, Singapore for the year 1909.—Notes on the cultivation of Para rubber and the yield or rubber crop.—Notes on experiments on the coagulation and curing of rubber.

Bulletins of the Department of Agriculture, Federated Malay States. No. 10.—A lecture on the Para rubber tree (a general account of the structure of the stem of *Hevea brasiliensis* and the relationship of this, to methods of tapping. The various methods of tapping are also described with the precautions which must be observed in following them. The latter sections deal with various aspects of the cultivation of Para rubber, particularly as regards planting distances, thinning out, pruning, "resting," etc.).

HONG KONG.

Report on the Botanical and Forestry Department, 1909.—An area of about 300 acres in the Harbour Belt was sown with pine seeds to the eastward of the plantations formed in 1908 (see this *Bulletin*, 1909, 7. 428). Replanting was carried out where necessary in the latter plantations, as well as in the Kowloon and Tytam Reservoir catchments, and in the felled areas of Mt. Kellet and Aberdeen. A large quantity of pine seed was sown broadcast in the Shing Mun Valley.

Seedlings of *Machilus Nanmu* (the "coffin wood" tree) were planted on the hillsides at Aberdeen and on Mt. Kellet and Mt. Victoria, but, judging from the rate of growth of a specimen in the Botanic Gardens, it is not expected that this tree will be of any economic value

in Hong Kong. At Kang Hau Nursery, trials are being made with economic plants, including Sisal hemp and *Aleurites Fordii*. Reference is made to a report on the investigation of the bark of *Aleurites Fordii*, *A. cordata* and *A. triloba* which was carried out at the Imperial Institute with the object of determining the value of these barks as tanning materials.

WESTERN AUSTRALIA.

Geological Survey Bulletin, No. **33**, describes geological work in the country lying between 21° 30′ and 25° 30′ South, and 113° 30′ and 118° 30′ East.

The rocks consist of the Ashburton beds, a metamorphic sedimentary series of unknown age; the Bangemall-Nullagine series—sandstones, conglomerates, dolomite and volcanic rocks; the Gascoyne beds—limestones, shales, sandstones and conglomerates of Carboniferous age; as well as gneiss and granite. A glacial deposit consisting of striated boulders in a calcareous clayey matrix occurs in the Gascoyne beds, and is succeeded by fossiliferous rocks with Carboniferous fossils. The economic minerals include gold, which occurs in quartz veins of the saddle-reef type in the metamorphic rocks. The auriferous quartz veins of Station Peak occur, however, in an altered rock described as a "quartz dolerite." The other auriferous areas of West Pilbara are more or less confined to the neighbourhood of the contact between the intrusive granite and the schists. Alluvial gold is also extensively distributed. Stream tin is found near the junction of the granite and metamorphic schists. Copper ores occur over a wide area in quartz reefs, sometimes in limestone and sometimes along shear zones. Lead, mica and copper occur together in lenticular ore bodies parallel with the bedding of mica schist and quartzite. Mica is found in pegmatite dykes, and valuable supplies of artesian water have been proved in the coastal area.

SOUTH AUSTRALIA.

Journal of the Department of Agriculture 1910, **13**. No. 11.—The reclamation and agricultural treatment of swamp lands. The effect of fire on soil fertility. No. 12.—Wheat improvements (gives a description of the provision made in South Australia for the improvement of local wheats and records the results so far obtained). Improvement of alkali lands. Spraying against the "codling moth" (gives the results of experiments with lead arsenate). Agricultural stations. (The average yield of wheat per acre was 13·26 bushels as compared with 11·45 bushels in the previous year, and the total yield was 25,133,851 bushels).

Government Geologist's Report on the Tanami Gold Country, Northern Territory.—Describes a journey from Pine Creek *via* Willeroo, Victoria River Downs, Wave Hill, Mucka, Hooker's Creek, Gordon Downs to Sturt Creek, as well as to Tanami and Invermay Station. The strata described include slates, sandstones, quartzites and schists

of pre-Cambrian age and ancient plutonic rocks, both these groups being metalliferous; also limestones, shales and sandstones in which Cambrian fossils have been identified. These are overlaid by an unfossiliferous series supposed to be Permo-carboniferous, and these again by basalt flows and Tertiary deposits.

Artesian water appears to be available in most places at a moderate depth. Gold occurs in reefs and alluvium.

Review of Mining Operations during the half year ended June 1909.—This half-yearly publication gives details of copper, silver-lead, gold and phosphate deposits, as well as of discoveries of gems including sapphire, chrysoberyl, ruby, aquamarine and topaz. Statistics of output are also furnished.

QUEENSLAND.

Department of Mines, Queensland Geological Survey, No. **223**.—A description of the almost abandoned Starcke Goldfield 15° South and 145° East, north-west of Cooktown. The gold occurs in fissures in slates forming part of sharply-folded sedimentary rocks, probably of Palæozoic age, interstratified with volcanic lavas and tuffs. These are overlaid by Trias-Jura beds. Alluvial gold has also been worked. Particulars are given of the different mines. No. **224**.—Notes on the main reefs of the Charters Towers Goldfield. The rocks consist of granite and diorite intersected by acid and basic dykes. Altered sedimentary rocks also occur in places. All these rocks are traversed by the fissure-lodes in which the gold is found, but the ground underlying the outcrops of the acid dykes appears to be unfavourable for gold. The character of the different fissure-lodes is discussed.

Government Mining Journal, 1910.—*January*. On making bricks from slag at the Great Fitzroy Mines—A new safety cage at Mount Morgan—Coal measures of South East Moreton—Self-dumping skips for underground tipping (from the *Journal of the Chamber of Mines* of Western Australia).

February. Mercury in Queensland and elsewhere—The Mount Flora Gold and Mineral Field (about 23° South and 148° East, lodes with various ores of copper associated with an intrusion of granite into slaty rocks).

March. A review of the Queensland mining industry for the year 1909 is given, the principal mineral products referred to being coal, gold, silver, lead, copper and tin; and among those of minor importance, tungsten, molybdenum, bismuth, antimony, manganese, iron ore, limestone (the two last used as fluxes in smelting operations), chromite, fireclay and gems (opals and sapphires); among the mineral products showing an increase were coal, the output of which expanded from 696,332 to 756,572 tons, wolfram, molybdenum, gems and fireclay. On recent discoveries of gold and silver lead ore on Mount Emu Plains Station in a granite mass connected with that extending past Cape

River, Charters Towers and Ravenswood to the coast, and with the granites of Croydon, Etheridge and Walsh and Tinaroo districts.

April. The West Moreton coal mines and the advantages of coal-cutting machines; the Eungella goldfield (21° South and 148° East, 40 miles west of the Mackay)—Particulars and explanations of the conditions on which samples are analysed for prospectors by the Mines Department.

May. The copper mines of the Mount Spencer Goldfield (21° 30′ South and 149° East, about 22 miles south-west of Mackay; the lodes fill the joint planes of the granite)—The quarterly returns of the mineral output of Queensland, showing a marked increase in the production of wolfram, the principal ore of tungsten.

June. Extracts from the Report of the Chief Inspector of Mines for 1909—Report on coal at Black Rock Creek, near Mackay, with high angle of dip and numerous shaly bands.

Agricultural Journal, 1910, **24**. Part 5.—Effect of grass on trees—Contributions to the flora of Queensland—Vanilla culture for tropical Queensland. Part 6.—Coffee cultivation in Queensland (a general article discussing shade, catch crops and manuring for coffee plantations). 1910, **25**. Part 1.—Asparagus culture—Formalin for seed wheat—Contributions to the flora of Queensland—Mamara cotton—Cotton growing—Coffee cultivation in Queensland—Ensilage from cane tops.

NEW SOUTH WALES.

Agricultural Gazette, 1910, **21**. Part 5.—Sheep and wool for the farmers (continued from the previous number; this part deals with the influence of climate on breed and the selection of types of sheep for particular localities)—Experiments with fungicides used for the prevention of "stinking smut" (the best all-round results were obtained with "fungusine," and the next best with a mixture of bluestone and salt)—Insectivorous birds of New South Wales—Examination of contents of stomachs and crops of Australian birds (a summary of the results for 57 species of birds is given)—The banded pumpkin beetle—Fruit flies and other insects attacking cultivated and wild fruits in New South Wales—Injurious substances in soils, producing bare patches, etc. (a general discussion of the causes of production of bare and infertile patches in soils)—A dangerous weed (a description of *Tribulus terrestris*, which produces a spiked fruit dangerous to cattle)—Artesian irrigation. Part 6.—Orchard soils of Cumberland, New South Wales—Insects which damage salt bush—Bathurst Experimental Farm: Annual Report of the demonstration area for 1909—Experiment farms (a description of the Bathurst farm is given)—Trials of varieties of kale at Bathurst. Part 7.—"Bitter pit" (gives a list of questions to be answered by owners of orchards with a view to obtaining information regarding the cause of this disease in apples)—"Irish blight" in tomatoes—Apples for cold storage—Spraying experiments at West

Maitland for the prevention of "potato blight"—Production and consumption of potatoes in New South Wales—"Irish blight" of the potato—Potato growing in the Clarence River district—Australian dry farming—Varieties of wheat recommended by the Department of Agriculture—Experiment farms (a description of the Cowra farm)—Barren sands—Vine growing and the phylloxera question.

VICTORIA.

Department of Mines. Geological Survey, Bulletin No. 23.—Contains biographical sketches of the members of the older Geological Survey from its commencement, with the appointment of Selwyn in 1852, to its abrupt termination in 1869.

Memoir No. 9.—Describes the Camperdown and Mount Elephant districts, 143° East and rather more than 38° South, almost in the centre of the great plain of basalt and tuffs that stretches from the frontier of South Australia to Port Phillip. The volcanic rocks rest on beds with numerous Tertiary fossils.

Journal of the Department of Agriculture, 1910, 8. Part 5.—Wheat Improvement Committee (deals with the experiments carried out, during 1909–10, at Longerenong Agricultural College, which included trials with new varieties, hybridisation experiments, etc. A second article deals with experiments on smut and rust resistance in wheat, oats, and maize)—The "smut" of maize and its treatment (deals with *Sorosporium reilianum* and *Ustilago zeae*; a full description of the former is given, and as remedial measures it is suggested (1) that all affected plants in a crop should be collected and burnt, and (2) that imported seed should be disinfected before sowing, using for this purpose a two per cent. solution of copper sulphate. The second fungus is not common in Australia, and as the spores are not killed by copper sulphate solution, the first remedial measure mentioned above is alone applicable)—A pioneer crop of maize in the Wimmera—Yield of reconstituted vineyard at the Rutherglen Agricultural College; vintage 1910—The wine industry in Southern France—Orchard studies—Maize and lucerne in the Western district. Part 6.—Limiting factors in agriculture—Testing potato varieties for "Irish blight"—Experiments with potato diseases, 1909–10—Sterilisation of soils—The rearing of queen bees—Closer settlement studies—The cork industry in Portugal—Maize for fodder. Part 7.—The genuine locust fungus (a description of *Empusa Grylli*, which attacks plague locusts in Australia)—The purification of muddy waters—Review of the dairying season and butter export trade 1909–10—Subsoiling—The wine industry in Southern France—Orchard studies. Part III—Shelter belts—Household insect pests.

BRITISH GUIANA.

Journal of the Board of Agriculture, 1910, 3. No. 4.—Mutual insurance of live stock—Rice cultivation (a general article describing

the cultivation and preparation of the grain)—Rubber in the North-Western district—"Corn smut" (describes the fungus *Ustilago maydis* and recommends the following remedial measures, (1) the cutting out and burning of all diseased heads, (2) the use of clean seed for sowing, (3) the treatment of seed in infected districts in a 1 per cent. solution of copper sulphate before sowing, and (4) the burning of all diseased plants).

WEST INDIES.

Imperial Department of Agriculture, Bulletin, 1910, **10.** No. 4.—The Agricultural Conference in Antigua, 1910 (a summary of the proceedings. The following papers were read: Five years' working of the Antigua sugar factory. Muscovado sugar-making by steam-boiling. Implemental cultivation. Systems of agricultural education)—Notes on some cacaos of the Dominica Botanic Station (Alligator and Tiger cocoas are described. The former, *Theobroma pentagona*, was introduced from Nicaragua to Trinidad, and thence to Dominica, and an experimental plot of sixty-two grafts on Forastero cocoa was formed. This has borne well at the Experimental Station, but the variety is not recommended for general cultivation in Dominica. Tiger cocoa, *Theobroma bicolor*, has grown well, but the beans obtained are of poor quality and have not been favourably reported on by experts in the United Kingdom. Monkey cocoa, *Theobroma angustifolia*, is also being grown experimentally)—The root disease of sugar cane in Antigua (as the results of an inquiry instigated by the Commissioner of Agriculture, it has been ascertained that disease, *Marasmius sacchari*, is prevalent in all districts of the island, and that although remedies for it are well known, they are not applied as generally as is desirable)—Root disease of sugar cane in Barbados—Disinfection of imported plants (a summary of the laws in force in the West Indies on this subject, with directions for preparing and using insecticides and fungicides).

Agricultural News, 1910, **9.** No. 211.—The black scale and its parasite (it is pointed out that although black scale, *Lecanium nigrum*, is common on cotton in the West Indies, it has not become a pest, probably owing to the fact that it is parasitised by *Zalophothrix mirum*). No. 212.—The Hardback Beetles (descriptions are given with notes on methods of destruction). No. 216.—Recent work on diseases of coconut palms (a summary of the results of recent investigations in Ceylon and Trinidad). No. 217.—The acid content of lime fruits—Agriculture in St. Vincent, Southern Grenadines and Carriacou—Carbon disulphide for killing weeds—"Dieback" diseases of Hevea cocoa and mango (a summary of recent information on this subject).

Sugar-cane Experiments in the Leeward Islands. Report on Experiments conducted at Antigua and St. Kitts in* 1908–09. *Part I. Experiments with Varieties of Sugar Cane. Part II. Manurial Experiments—Part I. contains the results of experiments with several newer varietie

of cane, as well as of others the value of which has been proved by extended trials in former years. The acreage devoted to each of the varieties and the average yield for each experiment station during the past eight years are given in appendices. Part II. contains an account of manurial experiments with ratoon canes which had not received artificial manures as plants. Reference is also made to the cultivation of ratoon canes and the value of molasses as a fertiliser for cane lands.

Bulletin of the Department of Agriculture (*Bahamas*), 1910, 5. No. 1. —Contains the report of the Board of Agriculture for the year 1909, in which details are given of the experimental work in progress with arrowroot, cassava, maize, cotton, fodders, pineapples, Ceara rubber, sweet potatoes and tobacco.

Trinidad and Tobago.

Annual Report of the Department of Agriculture, 1908–09.—The Department of Agriculture was formed in November 1908, and the present report deals only with the working during the five months ending March 1909. The sections of the Department comprise (1) the Government Laboratory, (2) the Botanical Gardens and (3) the various Government Estates, Experimental and Stock Farms. The reports by the responsible heads of these sections are published and the chief points are enumerated by the Director in a General Summary. Trinidad ranks fourth among the world's cocoa-producing countries and in view of the importance of this industry to the Colony, it is urged that the River Estate should be converted into a cocoa-experiment station, the present station at St. Clair not being successful so far as cocoa is concerned, the area available being too small. The shipments of coco-nuts in 1908–09 were the largest on record, viz. 18,658,519 nuts, valued at £57,284. Export of fruit does not make much progress, the prices realised by oranges being often unremunerative, whilst bananas often arrive at their destination in bad condition; and even when this does not happen the cost of handling and freight are so high as to leave very poor remuneration to the exporter. The sugar exported was valued at £462,019. The number of samples examined in the Government Laboratory was 1,363, most of these being of routine character. Amongst the miscellaneous samples of special interest were lignites, petroleum, cassava leaves (these yielding from 0·036 to 0·05 per cent. of prussic acid), and selected samples of seedling sugar canes from the Experimental plot attached to the laboratory.

Bulletin of the Department of Agriculture, 1910, 9. No. 65.—"Pod rot," "canker," and "chupon-wilt" of cocoa caused by *Phytophthora* species (it is shown that the first two diseases are caused by a species of *Phytophthora*, possibly *P. omnivora*. Methods of controlling these diseases by spraying are under investigation)—Cover and forage crops suitable for Trinidad (a number of leguminous plants are at present being grown experimentally at the St. Clair Station, and short descrip-

tions of these are given with notes on the soils they require, methods of cultivation, yield, etc.)—Carap oil (a *résumé* of information on the seeds and oil of *Carapa guianensis*. Compare this *Bulletin*, 1908, 6. 360)—Notes on some insect enemies in Tobago (gives short descriptions of the "cotton stainer," "tobacco horn worm," "tobacco bird worm," "tobacco flea beetle," "coconut blight," "Castilloa blight," "cocoa thrips," and "mealy bug," etc., with notes on preventive and remedial measures)—Economic Zoology in relation to Agriculture. Part I. Snakes—A new Tineid from Trinidad—Some freshwater fishes of Trinidad and Tobago—Report of the Mycologist for the year ending April 30, 1910—Report of the Entomologist for the year ending March 31, 1910.

CANADA.

Department of Mines, Mines Branch, 1910, No. 47. *Iron Ore Deposits of Vancouver and Texada Islands, British Columbia.*—The iron ores of Vancouver and Texada Islands are chiefly magnetites, only unimportant deposits of hematite and limonite being known. The magnetite occurs close to the contact of limestone and eruptive rocks; its distribution is very irregular, and it is impossible to estimate the extent of the deposits from the scanty development work so far carried out. In one or two localities, however, magnetic surveys indicate considerable ore bodies. The phosphorus content of the ore is low, but the sulphur high. Coal and limestone are available. The possibility of starting a local iron industry is discussed by the author. Assuming the ore supply to be capable of affording an adequate tonnage, he estimates the total cost of the pig-iron produced at $16 per ton. The price of imported pig-iron in British Columbia ranges from $22 to $31 per ton. This leaves a fair margin of profit, but the demand for pig-iron in the province is at present quite insufficient to support an iron industry. The west coast of the United States is closed as a market by a customs duty of $4 per ton on pig-iron, and it is not likely that British Columbia, handicapped by expensive labour and coal, could compete successfully with the rest of the world in Oriental markets. The Report is accompanied by five maps (Nos. 48 to 52), a general map of Vancouver and the adjacent islands, two magnetometric maps, a map of the iron mines on Texada Island, and a map of the bog iron ore deposits of West Arm, Quatsino Sound.

1910, Nos. 55 and 1107.—*Joint Report on the Bituminous or Oil-Shales of New Brunswick and Nova Scotia. Also on the Oil-Shale Industry of Scotland.*—In 1908 a consignment of oil-shale from Albert county, New Brunswick, was sent to Scotland to be tested on a commercial scale. The result was satisfactory, some 36 tons of the shale yielding on an average 40·09 gallons crude oil and 76·94 lb. sulphate of ammonia per ton. The shale was not from the richest seam known, but represented a fair sample of the New Brunswick oil-shales. The first part of this report includes an account

of the retorting and refining of the sample and deals with the history and technology of the Scotch oil-shale industry. The second part describes the occurrence of oil-shales in Canada, their geological position and their resemblance to the Scotch shales. The first part is illustrated by photographs and drawings of plant in the Scotch oil works. No maps are issued with the report, but these are stated to be in preparation.

No. 58.—*Annual Report of the Division of Mineral Resources and Statistics on the Mineral Production of Canada* for 1907 and 1908.—The total mineral production in 1908 was slightly less than in 1907, but well ahead of all previous years. Coal is still the most important product, accounting for 29·32 per cent. of the total value. Second place is now taken by silver, with 13·6 per cent., followed by gold, 11·45 per cent., copper, 9·79 per cent., and nickel, 9·58 per cent. The proportion in which the various provinces contributed to the total production, with the principal products of each, is as follows:—Ontario, 35·64 per cent. (silver, nickel); British Columbia, 27·58 (coal, copper, gold); Nova Scotia, 16·86 (coal); Quebec, 7·85 (asbestos); Alberta, 5·96 (coal); North-West Territories (Yukon), 4·27 (gold); Manitoba, 0·68 (clay products); New Brunswick, 0·68 (gypsum, coal); Saskatchewan, 0·48 (coal). Under the heading of nickel some account is given of the new alloy known as Monel metal. This is a silver-white metal, containing three parts of nickel to one of copper. It possesses most of the qualities of nickel, while its price is only two cents a pound above that of copper. The low cost of production is due to the fact that no attempt is made to separate the nickel and copper, which occur in the ore in the same proportion as in the alloy.

Geological Survey Branch, 1909, No. 1059. *A Geological Reconnaissance of the Region traversed by the National Transcontinental Railway between Lake Nipigon and Clay Lake, Ontario.*—This report deals with a strip of country extending 220 miles westward from Lake Nipigon. The whole of this region is underlain by pre-Cambrian rocks, consisting of gneisses, schists, and plutonic rocks of Laurentian, Keewatin and Huronian age, with a small area of little metamorphosed Keweenawan sediments in the extreme east. Pleistocene deposits have an irregular and somewhat scanty distribution. Only in places is the land of agricultural value. Gold occurs in small quantities in the Keewatin areas and is mined in the neighbourhood of Sturgeon Lake. The "iron formation" of the Keewatin-Huronian areas is a magnetite-bearing quartzite with variable iron content. Pyrite, often slightly auriferous, occurs; it is worked near Big Vermilion Lake. Felspar and muscovite may possibly prove of economic value. The report is illustrated by plates and geological maps on a scale of four miles to the inch.

1910, No. 1077.—*Geology of St. Bruno Mountain, Province of Quebec.*—St. Bruno is a small hill, rising to a height of 715 feet above sea-level, in the St. Lawrence Valley, fourteen miles east of

Montreal. The surrounding rocks are shales of Utica or Lorraine age (*i.e.* Ordovician). Intruded through these, and forming the greater part of the hill, is a mass which ranges from essexite to peridotite. There is also a small outcrop of a syenitic rock described as umptekite. The igneous rocks are described at some length in the memoir, which includes appendices on the fossils of the surrounding shales. There are also four plates and two maps, topographical and geological, on a scale of 800 feet to one inch. No. 1097.—*A Reconnaissance across the Mackenzie Mountains on the Pelly, Ross, and Gravel Rivers, Yukon and North-West Territories.*—This deals with pioneer work carried out along a single line across the Mackenzie Mountains. The topography of the district is described at some length; then follow sections on the climate, fauna, forests, transportation and geology. The rocks are mainly crystalline schists and Palæozoic, with comparatively small outcrops of Triassic, Cretaceous and Tertiary beds. Gold is the only mineral at present worked in the area. It occurs in the gravels of the Pelly River and some of its tributaries. Near Hoole Cañon a mineral resembling platinum was found in the concentrates; this, however, proved to be ferro-nickel. Other economic minerals occurring in small quantities are cassiterite, scheelite, bismuth, stibnite, zinc blende, arsenical pyrites, iron pyrites, hæmatite and lignite. The report is illustrated by nineteen plates and a "reconnaissance map" on the scale of eight miles to one inch. Two scales are given with the map; both are marked as miles, but the second is evidently a scale of kilometres. No. 1120.—*Summary Report for* 1909.—The report includes a general statement by the Director on the work of the Survey, and detailed accounts by the members of the staff of the work on which each has been engaged during the year. The report is illustrated by sketch maps and sections.

ONTARIO.—*Eighteenth Annual Report of the Bureau of Mines*, 1909. Part 1.—From the statistical review with which this volume opens it appears that the value of the minerals raised in the Province during 1908 amounted to $25,637,617, a figure which is in excess of all previous years. The output of silver shows an increase of nearly fifty per cent. as compared with 1907. In addition to an account of the mining operations of the year, the Report contains papers on the iron ores in the neighbourhood of Lake Nipigon, Round Lake, Black Sturgeon Lake, English River, Onaman Iron Range and Woman River; on the Lake Abitibi area; on Lake Ojibway, the last of the great glacial lakes; and on the classification and nomenclature of Ontario drift. Part 2 deals with the Gowganda and Miller Lakes silver area and the South Lorraine silver area; it was mentioned in this *Bulletin*, 1909, 7. 440. The volume is illustrated by numerous plates, including photomicrographs, and maps.

NOVA SCOTIA.—*Report of the Department of Mines*, 1909.—The greater part of this report deals with the coal mines of the Province. The total sales of coal during the year ended September 30, 1909,

amounted to $4,615,713, against $5,485,583 for the previous year. A portion of this decrease is attributed to strikes in certain of the collieries. The gold production showed a slight increase, its value being $239,353. The other mineral products worked during the year were arsenic, gypsum, barytes, building stone, brick- and pottery-clays. A certain amount of development work was carried out in iron, copper and lead-silver ores. The report is illustrated by plates.

Department of Agriculture.

Central Experimental Farm, Bulletin No. 65. *Growing and Using Corn for Ensilage or Forage Corn.*—The maize crop of Canada is of great and increasing importance. When made into ensilage, it constitutes a fodder which is useful for feeding cattle during the winter, and is of great value to the dairy and stock industries. An account is given of the cost of production, of the regions in which the plant can be grown, the varieties most suitable for planting, and the methods of preparing the soil and cultivating the crop.

ALBERTA PROVINCE.—*Department of Agriculture. Crop Bulletin,* 1910, No. 6, gives statistics of the grain crops for 1909. The total area under grain was 1,242,644 acres, and the total yield 36,761,493 bushels, being increases of 48 and 46 per cent. respectively over 1908.

GENERAL COLONIAL AND INDIAN PUBLICATIONS.

In the following paragraphs a summary is given of the more important contents of the chief Colonial official periodical publications received recently at the Imperial Institute, in so far as these relate to agriculture or to economic products and are likely to be of general interest.

UGANDA PROTECTORATE.

Official Gazette, 1910, **3**. No. 51.—The Supplement contains reports by the Imperial Institute on soils from the Busogo district, and on palm fruits collected in the Semliki Valley. A ton of coffee grown at Nsambya has been sold recently in London at the rate of 51*s.* per cwt. No. 57.—The Supplement to this number contains instructions for the tapping of rubber trees.

EAST AFRICA PROTECTORATE.

Official Gazette, 1910, **12**. No. 252.—In this number is published an Ordinance to prevent the introduction and spread of insect pests and diseases of plants, and another making provision for the examination, by the Agricultural Department, of maize, intended for export. Tenders are invited for the sole right to collect mangrove bark on a

concession at Ngomeni and Kilifi, and the conditions under which the right of collection may be exercised are given. No. 254.—Contains reports by the Imperial Institute on five samples of wattle bark from East Africa (see this *Bulletin*, 1910, **8.**, p. 249), and on a series of minerals from the Kisii and Kavirondo districts of the Protectorate.

NORTHERN NIGERIA.

Gazette, 1910, **11.** No. 4.—Contains (1) reports by the Imperial Institute on wild silk, rice, "black potash," sesame seed, wheat, guinea corn, and tobacco produced in Northern Nigeria, and (2) an article on the flora of Zaria province, with lists of plants and vegetables suitable for cultivation in gardens in that province. No. 5.—Contains an account of a tour made by His Excellency the Governor in the southern provinces.

GOLD COAST.

Government Gazette, 1910, No. 21.—Contains a report by the Imperial Institute on kernels of *Carapa guineensis*. No. 22.—Contains a report by the Comptroller of Customs on the trade of the Colony during the year 1909, with detailed statistics of imports and exports The following increases in values of exports are recorded:—Cocoa £214,526, rubber £95,550, palm kernels £34,604, copra £3,961. Decreases took place in the values of the following exports:—Gold and concentrates £156,670, timber £75,369, palm oil £85,557, copal £3,997. The total increase in exports amounted to £130,402. No. 34.—Contains the report of the Department of Agriculture for the quarter ending March 31, 1910, and gives particulars of the tours undertaken by the travelling instructors of the Department during that period. No. 55.—Contains a report on the work done by the travelling instructors of the Agricultural Department during 1909. It contains, *inter alia*, information regarding fungoid and insect pests on cocoa. A report by the Imperial Institute on the results of the examination of Funtumia rubber from the Gold Coast is also printed.

GAMBIA.

Colonial Reports, Annual, No. 541.—The Report for the Colony for 1909 states that the experiments in the cultivation of soy beans have not proved successful, and that the soil of the Colony seems to be unsuited to this crop. The manufacture of wood charcoal has been commenced, and during the year 102 tons were exported to the Canary Isles. There has been a large increase in the production of ground nuts, mainly due to the distribution of 500 tons of seed nuts by the Government last year.

ST. HELENA.

Colonial Reports, Annual, No. 638.—Experiments have been made during the year on the cultivation of new potatoes for the London market, and a small shipment was made which realised on the average £6 10*s.* per ton, and a further trial is being made this year. Similar experiments are being made with pears. The Colony now possesses three industries, viz. the production of Phormium fibre, lace-making, and fish-curing, the last having been started in February 1910.

SEYCHELLES.

Government Gazette, 1910, **34**. No. 39.—Contains a minute by the Curator of the Botanic Station, stating that in tapping Para rubber trees during the present season great difficulty has been experienced in preventing the latex from coagulating on the trees. The flow of latex from trees over twenty-four inches in girth was good, a single spiral cut giving in many cases fifty grams of latex per day. Large supplies of seed have also been obtained from the trees. At Abondance, a few Para trees were planted seven years ago in lateritic soil along with coconuts, the two trees growing side by side, and often only two yards distant from each other. In spite of these conditions, the rubber trees have shown good growth, and some of them are now twenty-five inches in girth. Rubber trees planted at Val d'Andore under similar conditions have also done well.

NOTICES OF RECENT LITERATURE.

NEW BOOKS.

LES PRODUITS UTILES DES BURSERACÉES. Par Andrée Guillaumin. Pp. 73. (Paris: A. Challamel, 1910.)

The natural order Burseraceae furnishes comparatively few economic products, and these few are not of great commercial importance. They include, however, such materials as myrrh, elemi and frankincense, all of which have presented special difficulties to the botanist, and some of which have been in use from very remote times, and for that reason are of great antiquarian interest. On these grounds quite a considerable literature has accumulated regarding these products, and there was room for a small volume, such as that now under notice, which would bring these scattered observations together. In the first chapter a *résumé* is given of information regarding the timber-yielding trees of the order. Many of the timbers are described as soft light woods suitable only for use in the localities in which they grow, but the timber of *Aucoumea klaineana* of the Gaboon is an exception in this

respect and was exported, according to the author, to the extent of 24,000 tons from the Gaboon in 1906, to be used as a mahogany substitute. The "Colophane" of Mauritius (this *Bulletin*, 1910, 8. 14) is another promising hard wood derived from this order of plants.

After a brief reference to the fruits and kernels of the Burseraceae the remainder of the book is occupied with the oleo-resins and gum resins, which form by far the most important economic products of the order. They include bdellium, myrrh, frankincense, elemi and other less-known products. "Mecca balsam" is included as a variety of myrrh, in spite of the fact that it differs from myrrh in type and is an oleo-resin, not a gum resin.

Under olibanum it is mentioned that this yields 4·7 per cent. of a volatile oil, but no reference is made to the researches of Wallach and of Schimmel & Co. on this oil, which showed that it contains pinene, dipentene, and phellandrene.

The chapter relating to elemis does not make it clear that the Manila variety alone is of commercial importance, and the curious statement is made that "elemi proper is extracted by distillation." There should also have been some reference made to the very important work of Vesterberg, and the more recent investigations of Clover on the composition of elemi. It is incorrect to refer to the elemis as "resins proper," since they are mostly oleo-resins.

The examples given are sufficient to indicate that this volume is not always a complete guide to the subject of which it treats. Nevertheless it contains much useful information, and is provided with a fairly complete bibliography. It is a distinct disadvantage that the book contains no index.

LES PLANTES À TUBERCULES ALIMENTAIRES DES CLIMATS TEMPÉRÉS ET DES PAYS CHAUDS. By Henri Jumelle. Pp. xiv. + 372. (Paris: Octave Doin et Fils, 1910.)

This volume is the second issued in the section of applied botany and agriculture of the *Encyclopédie Scientifique*, published under the general direction of Dr. Toulouse. The range of the complete series is very wide; the volumes are grouped into no less than forty sections, and in this section twenty-one are promised, the subjects including cereals, forage plants, the vine, sugar-producing plants, tobacco, gums and resins, the palms, the oil-yielding plants, etc.

The purpose of the book is to give an account of the plants bearing tuberous organs, which are used directly as food, or for the preparation of starch. Some fifty pages are first devoted to general botanical considerations. The external morphology and mode of origin of tuberous plant structures are described, the nature of the reserve materials present described, and tables indicating the range in size of the starch grains of the chief plants are given, together with a detailed summary of various schemes of classification of starch grains.

After this introductory portion separate chapters are devoted to the more important starch yielding plants which fall within the scope of the

volume. Those actually dealt with in detail are the potato, cassava, yams, sweet potato, the various arrowroot-yielding plants, and Coleus and Plectranthus.

In the concluding section the flowering plants are taken by Natural Orders, and a short account given of the chief species bearing tubers, accompanied by chemical analyses where available. Needless to say, "tuber" is not used here in its strict morphological sense, the fleshy roots of *Beta vulgaris*, for example, are included as well as true tubers, such as the potato or the yam.

A few notes on one chapter, of the main portion of the book, that dealing with the principal starch-yielding plants, will serve to indicate the mode of treatment. As an example the chapter on cassava will suffice. A brief historical account of the plant is given, and the question of whether there is more than one species of Manihot represented in the cultivated cassavas is discussed at some length, the author coming to the conclusion that both the bitter and the sweet cassavas are varieties of one species, *Manihot utilissima*. A good summary is given of the cultivation of the plant, and of the preparation of its principal products. The various cultivated varieties are described with, when known, a note as to their comparative value as starch producers. Diseases and pests are briefly noticed, and the chapter as a whole thus affords a very convenient summary of the subject.

The volume, which contains a moderate number of figures, ends with a bibliography and a good index.

LE PALMIER À HUILE, EN AFRIQUE OCCIDENTALE FRANÇAISE. Par Jean Adam. Pp. 274, with maps, plans and illustrations. (Paris: A. Challamel, 1910.)

The present value of Lagos palm oil is £38 per ton; at the same period of 1909 the value was £30. This rise in prices, which is common to all oil seeds and oils, is no doubt the reason for the attention that is being given in most European countries at the present time to the better exploitation of the oil palm forests of West Africa. The article published already in this *Bulletin* (1909, 7. 357) indicates what room there is for improvement in the direction of the more efficient working of these forests, and for the gradual replacement of the typical oil palm of West Africa by better varieties.

The book now under notice gives a *résumé* of information regarding the distribution, habits of growth, and cultivation of the oil palm in French West Africa, with information as to the economic products yielded by it, and their improvement in quality and quantity. In this part of the book a great deal of information is given, which will be of value throughout West Africa, wherever serious efforts are made to improve or extend the palm oil industry. In the concluding chapter the question of the working of oil palm forests, under European supervision, is considered, and it is pointed out that in most cases the forests are the property of native communities, and for that reason cannot well be the subject of concessions to European firms. The method suggested

for overcoming this difficulty is essentially that already indicated in this *Bulletin* (*loc. cit.*, p. 392), viz., the installation of central extracting factories for palm oil at suitable centres, where natives could sell the palm fruits they had collected in the forests belonging to their own communities.

M. Adam has already contributed a book on the ground-nut to this series of books on the oilseed-bearing plants of French West Africa, and both of these should be of great value to merchants and others interested in these products in West Africa.

MANUALI HOEPLI. L'INDUSTRIA DELLE MATERIE GRASSE. Vol. I. I GRASSI E LE CERE. Pp. xxiii. + 651. By Dottore S. Fachini. GOMME, RESINE, GOMMORESINE E BALSAMI. Pp. xvi. + 373. By Dottore L. Settimj. (Milano: Ulrico Hoepli, 1909.)

The series of manuals to which these two volumes were added towards the end of last year is well known throughout Italy, and deserves to be better known in this country as containing a great variety of handbooks on almost every branch of industry.

Dr. Fachini's book is the first of four volumes in the same series dealing with the industries connected with oils and fats. This first volume is divided into two parts, the first dealing with the general properties of fats and oils and of their hydrolytic products, the fatty acids and alcohols, and the second, occupying more than two-thirds of the whole, with the analysis of fats. The book is very well prepared, and is a useful addition to the works of reference already available on the subject of which it treats.

Dr. Settimj's volume on gums and resins and the allied substances, is a welcome addition to technical literature, since the books so far published on this subject are very few and are mostly of a highly specialised character, which prevents their use as ordinary works of reference. The author divides gums into three classes, "true," "mixed," and "astringent." The first class includes the ordinary Acacia gums of the Sudan and Senegal and the "semi-insoluble" gums produced in Persia. Tragacanth and similar "insoluble" gums form the second class, whilst the third contains kinos and similar products. It may be noted in passing that there is no more justification for regarding the kinos as gums than there is for including opium and maple syrup in this group of substances.

In the introductory note to the chapter on true gums it is regrettable to find the author repeating the venerable misstatement that the best gum of this class is obtained from *Acacia arabica* (pp. 15 and 16). The whole of the subject-matter on gums is compressed into 62 pages, so it may be imagined that the treatment is not exhaustive.

The section on resins commences with a general statement of their characters and physical properties, followed by a note on classification. On the latter point exception may be taken to the inclusion of the oleo-resins, such as turpentine, elemi, and copaiba in the class of "balsams,"

which in this country is generally reserved for resinous products containing esters of benzoic or cinnamic acid. Later chapters deal with the constituents of resins, in the course of which due reference is made to the important preliminary work of Tschirch and his colleagues in this branch, and with the methods of analysing resins. The remainder of the book, nearly 200 pages, deals with the description of the commercial resins, gum resins, and balsams. In most of these special chapters very little space is given to affording information regarding the important matters of distribution of the species yielding the products or to methods of collection and preparation, though this was doubtless unavoidable with the small space available.

In spite of the various defects referred to, this book will prove very useful, since it brings together in moderate compass a great deal of information hitherto almost inaccessible. It is provided with a useful index.

THE WEEDS, POISON PLANTS AND NATURALISED ALIENS OF VICTORIA. By Alfred J. Ewart, D.Sc., Ph.D., F.L.S., Government Botanist and Professor of Botany in the University of Melbourne, assisted by J. R. Tovey. Pp. viii. + 110. (Melbourne: J. Kemp, Government Printer, 1909.)

The farmer and agriculturist in Australia will welcome the issue of this useful handbook, which contains coloured drawings of all the "proclaimed plants" of which descriptions have appeared in the *Journal of the Department of Agriculture*, together with a popular account of the properties and best means of eradicating the common weeds of the State. The author conveniently deals with his subject under two headings. In the introduction to Part I. there is a description of the poisonous, injurious and proclaimed weeds (native and introduced), in which the factors which influence the spread of weeds are discussed. These include "Deforestation," "Pasturage Methods," "Grass and Forest Fires," "Drought," "Methods of Harvesting," and "Sale and Introduction of Impure and Infested Seed." Practical advice on the suppression of weeds, followed by a detailed account of the commoner ones, is given. The plates which illustrate this part of the book are a noteworthy feature, and though occasionally somewhat crude, they are sufficiently good to enable a novice to identify a particular weed without much difficulty. Part II. consists of a census of the naturalised alien plants and introduced exotic weeds of Victoria.

RAMIE (RHEA). By Herbert A. Carter. Pp. viii. + 144. (London: The Technical Publishing Co., Ltd., 1910.)

This work gives a detailed account of the fibre known as ramie, rhea, and China grass. The different varieties of the plant are described, and the methods of planting and gathering the crop in various countries, and especially in India, are fully dealt with. The methods of decortication and degumming and the various manufacturing processes

including preparation, spinning, weaving, dyeing, and finishing, are described. Three chapters are devoted to the ramie manufacturing industries of the United Kingdom, the Continent of Europe, and the United States of America, and a short account is given of experiments in ramie growing which have been carried out in various parts of South Africa. The purposes for which the fibre can be employed are specified, and an outline is given of the China grass and grass cloth industries of China. Reference is made to the Indian fibre, "ban rhea" (*Villebrunea integrifolia*), and its production and uses.

The book is well illustrated and forms a useful text-book, which should prove of considerable service to all who are interested in ramie fibre and the branches of industry connected with it, and especially to planters, manufacturers, and merchants.

THE MANUFACTURE OF LINEN, HEMP, AND JUTE FABRICS. Compiled by H. R. Carter. Pp. viii. + 89, with illustrations. (London: John Ball, Sons & Danielsson, Ltd., 1909.)

This volume comprises a series of articles which have appeared previously in the *Jute, Hemp, and Flax Trades Journal*. After dealing with the development of the weaving industry, as applied to the three materials mentioned, the compiler outlines the processes of manufacture under modern conditions. Cloth finishing and factory construction are also briefly dealt with. The illustrations are mostly general views of machinery used in warping, winding, weaving, and finishing.

ROPE, TWINE, AND THREAD MAKING. A Practical Handbook for the use of Rope, Twine and Thread Makers. Compiled by H. R. Carter. Pp. 151, with illustrations. (London: John Ball, Sons & Danielsson, Ltd., 1909.)

The aim of this book is to describe the methods adopted in making various kinds of rope and cordage. The processes involved in the manufacture of ropes of Manila and New Zealand hemp, wire ropes and cables, sewing thread and plaited lines are described; and illustrations are given of the machinery employed. The book will no doubt prove of interest to those engaged in the rope-making industry.

THE WOOL YEAR BOOK AND DIARY, 1910. Compiled by Aldred F. Barker, M.Sc. Pp. lxxv. + 352, and diary with illustrations. Second year of issue. (Manchester: Marsden & Co., Ltd., 1910.)

This book is compiled to serve the purpose of a pocket-book of memoranda for mill-managers, students and others interested in the woollen and worsted industries. In addition to much useful information of a general textile character, the work deals with the processes of manufacture from the raw material to the finished cloth. It contains a large number of diagrams and illustrations of machinery, which add largely to the value of a work which is likely to prove of great utility to those engaged in these industries.

HANDBOOK OF THE DESTRUCTIVE INSECTS OF VICTORIA. Prepared by Order of the Victoria Department of Agriculture by C. French, F.L.S., F.E.S., Government Entomologist. Part IV. Pp. 195. (Melbourne: Osboldstone & Co., 1909.)

It is a matter for regret that the parts of this useful handbook do not appear at more frequent intervals. The present instalment is dated 1909, but Part III. appeared as long ago as 1900. During the interim considerable progress has been made in the study of economic entomology. About twenty-five insect pests are described and figured in this volume. The coloured figures which accompany the descriptions give an excellent idea of the life-history of the species dealt with and will make identification fairly easy. Useful notes on the methods of prevention and extirpation are added. The insects which attack forest trees have been given a prominent place. Plates and descriptions of a number of insect-destroying birds are included.

PETROLEUM MINING AND OIL FIELD DEVELOPMENT. By A. Beeby Thompson, A.M.I.Mech.E., F.G.S. Pp. xx. + 362. (London: Crosby, Lockwood & Son, 1910.)

Mr. Beeby Thompson is already known as an authority on the mining of petroleum and allied products and the author of a comprehensive volume on the oil fields of Russia, which has been reviewed in this *Bulletin*.

In the present work he commences with a succinct survey of the oil fields of different parts of the world, giving statistics of the output of each area and some idea of its capabilities. So far as can be judged the information appears to be reliable and up to date. It is to be regretted, however, that the production is given sometimes in U.S.A. barrels, sometimes in Russian poods, and sometimes in metric tons. The subject of leases and royalties of oil property is also dealt with.

The author devotes some space to a consideration of the conditions under which petroleum is formed from organic matter, attaching importance to the occurrence of salt, which inhibits the normal processes of decomposition, and the presence of an impermeable covering of clay preventing the escape of volatile material. The influence of the structure of the beds in the distribution of the oil is also discussed, and some advice is given on prospecting for oil as well as the selection of sites for drilling. The author quotes, from a report of the late Mr. Grimes, of the Indian Geological Survey, on the Yenangyat oil district of Burmah, the curious fact that some outcropping sandstones show a higher temperature than the adjoining rocks, and that these, although they contain no petroleum at the surface, are invariably oil-bearing at a greater depth.

Considerable attention is given to the composition, physical properties, uses and distillation-products of rock oils and natural gaseous hydro-

carbons, and the methods of drilling and casing oil wells and extracting petroleum and natural gas are described in detail.

The work is illustrated with numerous figures and plates, though most readers would have preferred to have the latter printed in black rather than the brown tint that has actually been employed. It is a publication that should find a place in the library of every mining engineer and of every one interested in mineral oils either as an investor or merchant or as a consumer on a commercial scale.

FUEL AND REFRACTORY MATERIALS. By A. Humboldt Sexton, F.I.C. 2nd Edition. Pp. x. + 364. (London: Blackie & Son, Ltd., 1909.)

The section of this book devoted to the consideration of fuel consists of 323 pages, whilst 28 pages are considered sufficient for the treatment of refractory materials. The remaining pages are occupied by various tables and a comprehensive index

The work, on the whole, is very variable in quality, and insufficient attention is given to certain portions of the subject. For example, lignite or brown coal is passed over in a few lines, no mention being made of the increasing use of this material as fuel on certain foreign railroads, or of methods of briquetting it. This omission is doubtless due to the fact that lignite as a fuel is of little or no importance in this country, but in view of the large lignite industries that have grown up on the Continent there should have been some more extended reference to the subject in a general book of this description on fuel.

The various types of gas producer are dealt with fully in a rather elementary manner, and the subject of coke-ovens is also treated fairly comprehensively. The chapters on pyrometry and calorimetry are good, but the statement that the bomb calorimeter is too complicated for ordinary technical use is not altogether warranted. A long chapter deals fully with furnaces for metallurgical purposes, but in the final section refractory materials are treated very briefly.

The book should be useful to students or to those desirous of obtaining a general grasp of the principles of the subjects dealt with.

GEOLOGICAL SURVEY OF EGYPT: THE BUILDING STONES OF CAIRO NEIGHBOURHOOD AND UPPER EGYPT. *Survey Department Paper, No.* 16, 1910.

Chapter I. gives an account of the topography of the Cairo neighbourhood; the conditions affecting the value of building stones; and the chemical composition of the Cairo building stones, the best of which consist of nearly pure limestones containing practically no magnesium carbonate. Chapter II. contains a detailed description of the quarry areas. The best stone is developed along a line forming the northern edge of the Basatin cultivated depression, the limestones to the north and south of this area being more friable and of less value. The remaining four chapters deal with the methods of quarrying; the uses of Cairo limestones; and the building stones of Upper Egypt and Alexandria. A

catalogue of the building stones of the Cairo Geological Museum is given as an appendix.

HANDBOOK OF BRITISH GUIANA, 1909. Edited and compiled by Geo. D. Bayley and published under the authority of the Permanent Exhibitions Committee. Pp. xxvi + 607. (Georgetown: Argosy Company, Limited. London: Dulau & Co., Ltd., and Boston, U.S.A.: J. H. Stark.

A volume devoted exclusively to British Guiana and planned to afford information to those desirous of ascertaining the natural features of the country, the conditions of life there, the economic resources and chief industries, has long been wanting. There are excellent accounts in the Emigrants' Information Office *Handbook to the West Indies*, and in the *Pocket Guide to the West Indies*, but it is impossible owing to its relative size to do justice to British Guiana in works dealing generally with the West Indies. Thus whilst Trinidad is about the same area as Lancashire, and Jamaica approximately twice as large, British Guiana is equal to the combined area of England, Scotland and Wales. It is mountainous, intersected with a network of rivers which are, however, not always easily navigable, and much of the interior is as yet but little known and almost entirely undeveloped.

Speaking generally, British Guiana may be divided into three zones. (i) The rich alluvial coast belt, well adapted to and largely utilised for agriculture. (ii) The forest belt, yielding forest products and containing gold-bearing rocks. In this zone rubber promises to be of importance, as the native tree, *Sapium Jenmani* yields a good product, and the introduced *Hevea brasiliensis* also thrives. (iii) At higher elevations in the interior is a great savannah region suitable for cattle-ranching. A full account is given in the book of each of these regions and of any related industries or products.

A great deal of useful information is brought together, as for example in the notes on economic or interesting plants to be seen in the neighbourhood of Georgetown and other places. It is unfortunate that it has not been possible to facilitate reference to these in the index. Misprints in botanical names are somewhat numerous, and there are minor points to which exception might be taken. The book is very well illustrated, and as in addition to the treatment of the economic matters, indicated above, it appears to contain information on almost every other topic likely to be of interest to an inquirer, it should take its place as the standard work of reference on British Guiana.

ADMINISTRATIVE PROBLEMS OF BRITISH INDIA. By Joseph Chailly, Member of the French Chamber of Deputies. Translated by Sir William Meyer, K.C.I.E. Pp. xv. + 590, with coloured map. (London: Macmillan & Co., Ltd., 1910.)

The English edition of this interesting and readable book is being published simultaneously with the original in French. The author is a

distinguished authority on colonial matters in France, who has twice visited India to study the administrative system of that dependency. The results of his personal observations in India and his wide reading on the subject of Colonial Government are embodied in the present work. By permission, the book is dedicated by the translator and author to the Right Honourable Viscount Morley, O.M. The "Field of Administration" is the title of the first of the two parts into which the volume is divided. This part describes the country; the origins and diversities of Indian society, its beliefs and prejudices, and its ambitions and hopes. In Book II. "Britain's Indian Policy" is dealt with, and the questions, how best to govern such a society as that found in India without wounding its susceptibilities, and how to reconcile its numerous and complex interests with those of the governing people, are discussed. In view of the recent proposals for giving natives of India a larger share in the administration of the country, the opinions and suggestions of an eminent French observer in this connection will be read with interest in this country. The book is printed in large type on good paper, and is provided with a full index and a coloured map of India and adjacent countries.

THE PASTORAL HOMES OF AUSTRALIA. Vol. I.—Victoria. Published by the *Pastoralists' Review*, Melbourne, Sydney and London. (1910).

This handsomely bound book is the first of a series of volumes dealing with the great pastoral estates of Australia. The scope of the work is somewhat novel. It includes histories of 56 prosperous estates in Victoria, each section being beautifully illustrated by photographs depicting various branches of farming in the State, such as wool-growing and dairying. Views of homesteads and portraits of the various property owners, which include some of the best-known pastoralists, are a prominent feature and add considerably to the attractiveness of the book. Such a work as this gives an idea of the immense growth of the pastoral industry in Victoria during the last half-century. Almost every "Pastoral Home" described in this volume lies in that portion of Victoria which is bounded on the north by the Grampians, on the west by the Eumeralla River, on the east by the Yarra Yarra, and by the ocean on the south.

MISSIONS AU SAHARA. Par E.-F. Gautier et R. Chudeau. Tome II, SAHARA SOUDANAIS. Par R. Chudeau. Pp. 326. (Paris: Librairie Armand Colin, 1909.)

The present work, together with the previously issued volume by M. Gautier on the Algerian Sahara, completes the record of a survey of the vast region of North Central Africa which has received so much attention at the hands of French travellers in recent years. The area dealt with by the Sahara Mission was for convenience divided into the Algerian Sahara and the Sudan Sahara; and now that the two reports

are available, it would appear that this conventional division was not without other justification, since it became evident that, from the topographical, geological, botanical and ethnological standpoints, the Sahara may be divided into the two great regions described above. In the present volume, the author contrasts the two areas, and demonstrates that the essential differences in population, language, and flora are to a large extent dependent upon different geological conditions. The Algerian Sahara consists of vast expanses of recent sedimentary deposits, presenting a comparatively flat or low rolling type of country which allows of relatively easy communications. As a result, the region has presented no great difficulties to a penetration southwards of peoples from the north, and at the present day the Algerian Sahara possesses a dominant population of Arab type speaking Arabic. The Sudan Sahara, however, is of a very different character, the ancient crystalline rocks weathering slowly into sand or a thin sterile soil; it is only in a few widely separated areas that conditions are possible for human life, and the maintenance of communication is a matter of the greatest difficulty. Thus geological and geographical barriers have resulted in the preservation of the Touareg and other native peoples from inroads from the north, and left them relatively undisturbed with their languages and customs. To the south of the desert there is another well-defined area forming a strip of territory reaching westwards to the Mauritanian region. This zone is in no way part of the desert. The geological conditions resemble those of the Algerian Sahara, and there is a wet season with a small but regular rainfall. From the ethnological point of view this country constitutes, in its eastern and central portions, a natural transition between the Sahara and the true Sudan.

The volume is largely concerned with geological considerations, and there is appended a coloured geological map and several provisional sections. A most important chapter is that on the flora of the country. The Sahara forms a definite botanical region, easily recognised over the greater part of its area by the scarcity of vegetation. In many districts vegetable life is entirely absent, but the popular belief that this is true for the Sahara as a whole is erroneous. The author distinguishes three botanical zones: the first, constituting the Algerian Sahara, is characterised by plants abundant in the Mediterranean region, *e.g.* *Pistacia atlantica*, *Tamarix gallica*, *Acacia tortilis*, *Populus euphratica*, *Retama Retem*, and others. It was the occurrence of this Mediterranean element that led to the view that, botanically, the Sahara is to be regarded as a dependent of the Mediterranean region. In the present work, however, the author shows that this view has resulted from the explorations of the desert being carried out hitherto from the north, southwards. His second zone, that of the Sudan Sahara, possesses a flora essentially, as regards species, that of the true Sudan, important plants being *Balanites Aegyptiaca*, *Salvadora persica*, and *Leptadenia Spartum*. A third botanical region is found in the mountainous country of Ahaggar, in the north of the Sudan Sahara. The highlands

of this area, being not wholly without water, bear a vegetation sharply distinguished from that of the surrounding country. The typical species of the latter are rare and occur only at the lower levels, where they are found with *Capparis spinosa*, *Deverra fallax*, *Olea* sp., *Zizyphus* sp., *Calotropis* sp., and *Tamarix gallica*. Trees are very scarce. In certain districts at higher altitudes the land levels allow of an accumulation of water, where a most interesting flora exists, including well-known European species of Veronica (*V. anagullis*), Mentha (*M. sylvestris*), *Juncus* spp., *Scirpus* spp., *Typha* spp., *Epilobium* spp. and numerous Gramineae.

The book is illustrated with a large number of photographs and drawings, and there is a good index.

HANDBUCH DER KLIMATOLOGIE. Von Dr. Julius Hann. Band II. Klimatographie I. Teil. Klima der Tropenzone. Dritte, wesentlich, umgearbeitete und vermehrte Auflage. Pp. xii. + 426. (Stuttgart: Verlag von J. Engelhorn, 1910.)

Hann's treatise on Climatology has long been considered the standard work on the subject. The volume under review is in its third edition and deals with the climates of the tropical zone, which is taken in general to include those places lying between the northern and southern annual isothermal lines of 20° C. (68° F.). The mean extension northwards of this zone is 30° of latitude and southwards 26°; it corresponds approximately to the limits of the growth of the palm, the characteristic plant of the tropics. The author first discusses the general characteristics of tropical climates as to temperature, atmospheric pressure winds, rain, humidity, cloud and light intensity. He points out that in the tropics changes of the mean temperature are of less importance in dividing the year into seasons than the periods of rain, dryness and the prevailing winds. The variability of the weather which characterises the more northern and southern latitudes disappears, and the weather becomes the same as the climate. He gives an interesting section on the effect of tropical climate on mankind and its relation to disease; he remarks that in the tropics the skin does not so readily adjust itself to meet the effect of cooling, and quotes General Wolseley as saying that in the tropics the avoidance of chills is the surest safeguard against nearly all diseases. He then deals in detail with the climates of different localities, grouping them under the headings: West Africa, East Africa and the Sudan, the monsoon regions of Asia and north Australia, the islands of the Pacific Ocean and the American tropics; giving particulars of the greatest importance to residents and travellers.

LIBRARY.—RECENT ADDITIONS.

Books, etc., exclusive of periodical Government Publications, presented to the Library of the Imperial Institute since December 21, 1909. The names of donors are printed in italics.

INDIA:—Report of the Bengal Chamber of Commerce, 1908.—Appendices, and 1909, Vol. I. (*The Secretary.*) Times of India Calendar and Directory, 1910; Thacker's Indian Directory, 1910; The Asylum Press Almanac and Directory of Madras and Southern India, including Burma, 1910. (*The Secretary of State for India.*) Calcutta, Faces and Places in Pre-Camera Days, Part 1. By W. Corfield. (*Calcutta Historical Society.*) Proceedings of the Madras Chamber of Commerce, 1909. (*The Secretary.*) Report of the Burma Chamber of Commerce, 1909, with Appendices. (*The Secretary.*) Report of the Bombay Chamber of Commerce, 1909. (*The Secretary.*) Calendar of the University of Calcutta, 1910–11. (*The Registrar.*) Fauna of British India; Coleoptera—Hamellicornia (Cetoniianae and Dynastinae). By G. J. Arrow. (*The Secretary of State for India.*)

CEYLON:—The Ceylon Handbook and Directory and Compendium of Useful Information, 1909–1910. Edited by J. Ferguson, C.M.G., M.L.C.; The Ceylon Manual, 1910. (*Crown Agents for the Colonies.*) Reports of the Ceylon Chamber of Commerce (Incorporated) for the half-years ended December 31, 1909, and June 30, 1910. (*The Secretary.*) Report of the Agricultural Society, 1909–1910, and Progress Report No. 50. (*The Secretary.*)

STRAITS SETTLEMENTS:—Report of the Singapore Chamber of Commerce, 1909. (*The Secretary.*)

AUSTRALIA:—The Weeds, Poison Plants and Naturalised Aliens of Victoria. By A. J. Ewart, D.Sc., Ph.D., F.L.S., assisted by J. R. Tovey. (*The Director of Agriculture.*) Transactions, Proceedings and Reports of the Royal Society of South Australia. Vol. XXXIII., 1909. (*The Secretary.*) Annual Report of the South Australian Chamber of Manufacturers (Incorporated), 1909. (*The Secretary.*) Annual Report of the Adelaide Chamber of Commerce, 1909–10. (*The Secretary.*) Walch's Tasmanian Almanac, 1910. (*The Agent-General for Tasmania.*) Queensland Geographical Journal (New Series), including the Proceedings of the Royal Geographical Society of Australasia (Queensland). Vol. XXIV., 1908–9. (*The Secretary.*) Handbook of the Territory of Papua. Compiled by the Hon. Staniforth Smith. Second Edition, 1909. (*The High Commissioner of the Commonwealth of Australia.*) Victoria Geographical Journal, including the Proceedings of the Royal Geographical Society of Australasia (Victoria). Vols. XXII.–XXVII. (*The Secretary.*)

NEW ZEALAND:—Annual Report and Statistics of the Wellington Harbour Board, 1908–1909. (*The Secretary.*) Annual Report of the Wellington Chamber of Commerce, March 1910. (*The Secretary.*) Calendar of the University of New Zealand, 1910–11. (*The Registrar.*)

SOUTH AFRICA:—List of the Flowering Plants and Ferns of the Cape Peninsula, with notes on some of the Critical Species. Compiled by H. Bolus, F.L.S., and Major A. H. Wolley-Dod; Revised List of the Flora of Natal (from the "Transactions of the Royal Society of South Africa," Vol. I., Part II. January, 1910). Compiled by J. Medley Wood. (*J. Medley Wood, Esq.*) Proceedings of the Rhodesia Scientific Association, Vol. VIII., Parts I. to III., 1908–09. (*The Secretary.*) Vol. VIII., Part III.—The Rainfall of Rhodesia. By the Rev. E. Goetz, S.J., M.A., F.R.A.S. (*Meteorological Committee, London.*) Report of the Executive Committee of the Rhodesia Chamber of Mines, 1909; Annual Report of the Rhodesia Chamber of Mines, 1909. (*The Secretary.*) Transactions of the Geological Society of South Africa, Vol. XII., 1910. (*The Secretary.*) Annual Report of the Transvaal Chamber of Mines, 1909. (*The Secretary.*) Annual Report of the Johannesburg Chamber of Trade, 1909–1910, and Commercial Year Book, 1910. (*The Secretary.*) South Africa as a Field for Settlers; Land and Farming Prospects in the Transvaal and Swaziland. (*Settlers' Emigration Society.*)

NYASALAND:—The Handbook of Nyasaland, Second Edition, 1910. (*The Editor.*)

MAURITIUS:—The Mauritius Almanac for 1910. (*The Colonial Secretary.*)

GIBRALTAR:—Gibraltar Directory and Guide Book for 1910. (*The Colonial Secretary.*)

CANADA AND NEWFOUNDLAND:—Journal of the Mining Society of Nova Scotia. Vol. XIV., 1909–10. (*The Secretary.*) Documentary History of Education in Upper Canada, Vol. XXVIII. 1876. By J. G. Hodgins, I.S.O., M.A., LL.D. (*The Minister of Education.*) Through Newfoundland with the Camera, Second Edition. By R. E. Holloway, B.A., B.Sc. (*The Premier of Newfoundland.*) The Proceedings and Transactions of the Nova Scotian Institute of Science, Vol. XII., Part II., 1907–1908. (*The Secretary.*)

WEST INDIES:—The Grenada Handbook, Directory and Almanac for the year 1910. (*The Crown Agents for the Colonies.*) The Trinidad and Tobago Year-book, 1910. Compiled by J. H. Collins. (*The Colonial Secretary.*)

UNITED KINGDOM:—Rubber Companies' Statistics: A Comparative Analysis of the Position of the Leading Rubber Plantation Companies. Compiled by A. Shephard. (*The Compiler.*) National Museum of Wales: First and Second Annual Reports, 1908, 1909.

(*The Director.*) Twenty-second Annual Review of the Frozen Meat Trade, 1909. (*Messrs. W. Weddel & Co.*) Directory of the Royal Society of Arts. Edited by Sir Henry Trueman Wood, M.A. (*The Secretary.*) The Newspaper Press Directory, 1910. (*The Publishers.*) Proceedings of the Anglo-Russian Literary Society, October 1909 to July 1910. (*The Secretary.*) Royal Society of Edinburgh: Proceedings, Vol. XXX., Parts I. to VI.; Transactions, Vol. XLVII., Parts I. and II., and General Index, 1889–1908. (*The Secretary.*) Annual Report of the Leeds Incorporated Chamber of Commerce, 1909. (*The Secretary.*) Directory of Paper Makers, 1910. (*The Publishers.*) The Stock Exchange Official Intelligence, 1910. (*The Secretary.*) The Journal of the Royal Agricultural Society of England, Vol. LXX. 1909. (*The Secretary.*) Catalogue of the Library of the India Office, Vol. I., Supplement 2, 1895–1909. (*The Secretary of State for India.*) Transactions of the Highland and Agricultural Society of Scotland, Fifth Series, Vol. XXII., 1910. With Index to Vols. XV.-XXI. (*The Secretary.*) Transactions of the Royal Scottish Society of Arts, Vol. XVII, Part III. (*The Secretary.*) Oriental Commerce, 2 Volumes, 1813. By W. Milburn. (*Colonel D. G. Pitcher.*) Tenth and Eleventh Reports of the Woburn Experimental Fruit Farm. (*The Director.*) Catalogue of the Tamil Books in the Library of the British Museum. Compiled by L. D. Barrett, M.A., Litt.D., and the late G. W. Pope, D.D.; Supplementary Catalogue of Hindustani Books in the Library of the British Museum, acquired during the years 1889–1908. By J. F. Blumhardt, M.A. (*The Trustees.*) Proceedings of the Twelfth International Congress on Alcoholism. (*The Secretary.*) Report of the Council of the Metropolitan Borough of Battersea, 1908–09. (*The Town Clerk.*) Livingstone College Year Book, 1910. (*The Principal.*) British and Foreign State Papers, Vol. XCIX., 1905–06. (*The Secretary of State for Foreign Affairs.*) Annual Report of the University of Leeds, 1908–1909. (*The Secretary.*) Transactions of the Institute of Naval Architects, 1910. (*The Secretary.*)

EGYPT:—Mémoires présentés a l'Institut Égyptien. Tome VI., Fasc. 1.—Catalogue de la Faune Malacologique d'Egypte. By P. Pallary. Fasc. 2.—Description des Echinides Fossiles recueillis par MM. W. F. Hume et J. A. Ball. (*The Secretary.*)

FRANCE:—Les Végétaux utiles de l'Afrique Tropicale Française, Fasc. VII. (1re Partie).—Documents sur le Palmier a Huile. By A. Chevalier. (*The Author.*) Annales de Musée Coloniale de Marseille. 2e Série, 7e Volume (1909). (*The Director.*)

GERMANY:—Jahresbericht der Handelskammer zu Hamburg, 1909. (*The Secretary.*) Jahresbericht der Deutschen Gerberschule zu Freiberg in Sachsen. No. 21, 1909–10. (*The Director.*)

HOLLAND:—Katalog des Ethnographischen Reichsmuseums, Leiden:-

Band I.—Borneo; Band IV.—Die Inseln Rings um Sumatra; Band V.—Javanische Altertümer. (*The Director.*)

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PORTUGAL:—The Delagoa Directory, 1910. (*The Publishers.*) Associação Commercial do Porto: Relatorio da Direcção no Anno de 1909. (*The Secretary.*)

UNITED STATES:—Annual Report of the Smithsonian Institution, 1908. (*The Director.*) Founders' Week Memorial Volume—Philadelphia, 1683–1908. Edited by F. P. Henry, A.M., M.D. (*The Editor.*) Freemasonry in Pennsylvania, 1727–1907. By N. S. Barrett and J. S. Sachse. (*Grand Lodge of Pennsylvania.*) Eleventh Report of the Michigan Academy of Science, 1909.—Darwin Centenary Publication. (*The Secretary.*)

BULLETIN

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IMPERIAL INSTITUTE

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SCIENTIFIC AND TECHNICAL DEPARTMENT.

RECENT INVESTIGATIONS.

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Colonial and Indian Governments concerned.

PARA RUBBER (*HEVEA BRASILIENSIS*) IN SOUTHERN NIGERIA.

IN a previous note in this *Bulletin* (1909, 7. 200) a short account was given regarding the introduction of the Para rubber tree (*Hevea brasiliensis*) into Southern Nigeria and the results of its experimental cultivation in that country. It has been found that the Para tree can be successfully grown in many parts of the wet zone of Southern Nigeria (south of 6° 15′ north latitude), and the plantations of the trees which have been established by the Forestry Department and by private firms are being gradually extended.

During the latter part of 1909 two series of tapping experiments were conducted by Mr. T. Christ, of the Forestry Department, on Para trees growing at Ebute-Metta and Orugbo, and the rubber obtained was forwarded to the Imperial Institute for

chemical examination and subsequent sale. A summary of the results of the investigation will therefore be of interest as indicating the yield and quality of the rubber furnished by Para trees in Southern Nigeria.

TAPPING EXPERIMENTS AT EBUTE-METTA.

The first Para trees introduced into Lagos were planted in the Botanic Gardens at Ebute-Metta. The oldest existing trees are of uncertain age, but are now probably 16 years old, as the first consignment of *Hevea brasiliensis* seedlings was sent to Lagos in 1894. Some confusion has arisen regarding the botanical identity of these old trees in the Gardens, owing to the fact that although they all appeared to belong to the same species, some of them had been labelled *Hevea brasiliensis* and others *Hevea Spruceana*. In July 1910, however, flowering specimens of the two groups of trees were forwarded to Kew for determination, with the result that the identity of those labelled *H. brasiliensis* was confirmed, whilst those labelled *H. Spruceana* were found not to belong to that species, but to represent another form of *H. brasiliensis*. It is therefore definitely established that all the old Para trees at Ebute-Metta belong to *H. brasiliensis*.

In view of these determinations it seems very probable that the statement recently made by M. Yves Henry (this *Bulletin*, 1910, 8. 183) that *Hevea Spruceana* has given much more promising results than *Hevea brasiliensis* in West Africa cannot be maintained. The trees of supposed *H. Spruceana* at Porto Novo, the returns from which form the main support of his opinion, were derived from Ebute-Metta, and are no doubt similar to those which are now proved to be a form of *H. brasiliensis*.

Five of the trees labelled *H. brasiliensis* had been experimentally tapped in 1908, and four of these were chosen for further trials in 1909, together with two trees which were then thought to be *H. Spruceana*, but are now known to be a form of *H. brasiliensis*. The experiments extended from the 22nd September to the 18th November, 1909, the trees being tapped on alternate days, and the returns from the two groups of trees were kept separate. The results are summarised in the following table:—

	No. of tappings.	Daily yield of dry rubber.		Total yield of dry rubber.	Average total yield per tree.	Average yield per tree for each tapping.
		Minimum.	Maximum.			
(*a*) Four trees—average girth 37 inches . .	26	1¼ oz.*	4 oz.†	4 lb. 15 oz.	20 oz.	0·8 oz.
(*b*) Two trees—average girth 40 inches . .	25	nil *	2½ oz.‡	1 lb. 10⅝ oz.	13 oz.	0·5 oz.

* *First tapping.* † *20th and 22nd tappings.* ‡ *19th tapping.*

It will be seen from these figures that the yield of rubber from the second group of trees was much less than that from the first, and it is suggested that this may possibly be due to the fact that the two trees forming the second group were tapped for the first time, whereas the other four had been tapped the previous year.

These yields of rubber, especially that given by the first group of four trees, are exceedingly promising, but further experiments are required in order to determine whether they will be maintained on tapping during a longer period than two months. It was proposed to tap the trees regularly during the greater part of 1910, except in the very dry months, and the results will be awaited with much interest.

Three specimens of the biscuit rubber obtained in these tapping experiments at Ebute-Metta during 1908 and 1909 have been examined at the Imperial Institute. All the specimens were very similar in appearance, consisting of biscuits of light-brown rubber, which was clean and well prepared. The physical properties of the rubber were very satisfactory.

The results of the chemical examination of the three specimens are given in the following table:—

	Rubber obtained in 1908. (1)	Rubber obtained in 1909.	
		From 4 trees tapped previously in 1908. (2)	From 2 trees tapped for first time. (3)
	Per cent.	*Per cent.*	*Per cent.*
Moisture	0·6	0·6	0·5
Caoutchouc	95·0	95·2	92·4
Resin	1·7	1·7	4·9
Proteid	2·3	2·1	1·9
Ash	0·4	0·4	0·3

The figures show that specimens (1) and (2) derived from the same trees in 1908 and 1909 respectively are practically identical in composition, and that they are quite equal in this respect to plantation Para rubber from Ceylon or Malaya.

The rubber obtained from the two trees tapped for the first time in 1909 contains a much higher percentage of resin than that from the other group of trees. As already indicated, these two trees were believed at the time to be *Hevea Spruceana*, but have now been determined as a form of *Hevea brasiliensis*, and it will be of interest to see whether this high percentage of resin in the rubber will be maintained in the product obtained in subsequent tappings.

The rubber from the 1908 tapping was valued at 5*s.* per lb. in London with fine hard Para quoted at 5*s.* per lb. and fine plantation Para at 5*s.* 1*d.* to 5*s.* 8*d.* per lb.; the specimens obtained in 1909 were valued at about 9*s.* per lb. in London with fine hard Para at 9*s.* 10*d.* per lb. and fine plantation Para at 10*s.* 1*d.* to 10*s.* 6*d.* per lb.

TAPPING EXPERIMENTS AT ORUGBO.

A series of tapping experiments was also conducted on Para trees (*Hevea brasiliensis*) at the Rev. J. E. Wright's plantation at Orugbo. One hundred 8-year-old trees were selected for trial, and were divided into two groups: (1) 50 trees with an average girth of 25 inches, and (2) 50 trees with an average girth of 22 inches; in addition, three trees which had been tapped in August 1909 were re-tapped. The experiments extended from September 19 to October 30, 1909, and the tappings were made on alternate days, with the exception that the 50 trees of the first group were tapped every day for one week. The half herring-bone system was employed, the vertical channel being made 6 feet high and the lateral cuts 6 inches long. The results obtained are summarised in the table on page 345.

A comparison of this table with the preceding one giving the results at Ebute-Metta shows that the average yield of dry rubber per tree obtained at Orugbo in these experiments was much less than at Ebute-Metta. Further data will, however, be necessary before any definite comparison can be made, as the

trees at Ebute-Metta are almost twice the age of those which were tapped at Orugbo.

	No. of tappings.	Daily yield of dry rubber.		Total yield of dry rubber.	Average total yield per tree.	Average yield per tree for each tapping.
		Minimum.	Maximum.			
(1) 50 trees—average girth 25 inches . .	23	2 oz.*	1 lb. 5½ oz.†	20½ lb.	6·5 oz.	0·3 oz.
(2) 50 trees—average girth 22 inches . .	21	2½ oz.*	14½ oz.‡	14 lb. 2⅝ oz.	4·5 oz.	0·2 oz.
(3) 3 trees previously tapped **	20	nil *	2 oz.§	1 lb. 2 oz.	6 oz.	0·3 oz.

* *First tapping.* † *21st tapping.* ‡ *15th and 17th tappings.* § *15th tapping.*
** *These three trees gave 9 oz. of dry rubber in 8 tappings in August 1909.*

The rubber obtained in the experiments at Orugbo was forwarded to the Imperial Institute for examination and subsequent sale. The consignment weighed about 30 lb., and consisted of light-brown biscuits, which were well prepared but of rather rough appearance. The rubber exhibited very good physical properties.

On analysis the following results were obtained :—

	Rubber as received.	Composition of dry rubber.
	Per cent.	*Per cent.*
Moisture	3·5	—
Caoutchouc	90·8	94·1
Resin	3·6	3·7
Proteid	1·9	2·0
Ash	0·2	0·2

The results of the chemical examination show that the dry rubber is of very satisfactory composition, though not quite equal in this respect to two of the specimens from Ebute-Metta owing to the presence of a higher percentage of resin. The biscuits as received contained a larger amount of moisture than is usually present in plantation Para biscuits, but apart from this they compare very favourably in composition with Para rubber from Ceylon and Malaya.

The small consignment of the rubber was offered for sale in London, and realised 8*s.* 10¼*d.* per lb., with fine hard Para at 9*s.* 10*d.* per lb. and fine plantation biscuits at 10*s.* 1*d.* to 10*s.* 6*d.*

per lb. This price must be considered very satisfactory for such a small lot of rubber. With more practice in making the biscuits in Southern Nigeria the rubber will probably be much improved in appearance, and will then realise a better price if offered in commercial quantities.

CONCLUSIONS.

The examination of these specimens of Para rubber from Ebute-Metta and Orugbo has shown that the product is of excellent quality, and quite equal in composition to the plantation Para from Ceylon and Malaya. It is too early to draw any definite conclusions from the results of the tapping experiments, but the yields of rubber so far obtained from Para trees in Southern Nigeria are very promising, and if maintained when tapping is continued through the greater part of the year the returns will be very satisfactory.

The prospects of Para rubber cultivation in Southern Nigeria are therefore very encouraging, and it is hoped that the further experiments now in progress will confirm the favourable results recorded in this article.

THE RUBBER OF *MASCARENHASIA ELASTICA.*

IN 1898 a new rubber-yielding tree was discovered by Dr. Stuhlmann in the neighbourhood of Dar-es-Salaam, German East Africa, and from the botanical specimens which he collected the plant was determined by Dr. K. Schumann as a new species of Mascarenhasia to which the name *Mascarenhasia elastica* was given. The plant was described as a small tree, from 30 to 40 feet in height, with slender branches; the trunk usually branches low down and is covered with greyish bark. The leaves are opposite, oblong, obtuse or obtusely and shortly acuminate, acute at the base, and coriaceous; they vary from 3 to 10 inches long and from 1¼ to 2½ inches broad. The flowers are conspicuous and fragrant; the follicles are purplish-black and from 3 to 3½ inches long.

Like other species of the genus, *Mascarenhasia elastica* furnishes rubber which is collected to some extent by the natives and is known as M'goa or Goa rubber in East Africa. It is stated, however, that the latex flows so slowly that the collection of the rubber is not profitable, and that owing to the crude methods employed the product is of inferior quality and low value.

Mascarenhasia elastica is reported to be fairly common in the neighbourhood of Dar-es-Salaam, growing principally on the banks of streams or in moist situations. The trees have smooth, straight trunks, which are used by the natives for building their houses, and it is for this purpose, rather than as a source of rubber, that they are chiefly prized.

Experiments which have been made in German East Africa on the cultivation of the tree have shown that it grows quickly even in dry soil, and flowers and fruits when five years old. The yield of latex at this age was, however, only slight.

For some years after its discovery in German East Africa, *Mascarenhasia elastica* was not recorded from any other locality, but it has since been found in the East Africa Protectorate, the island of Pemba, and Portuguese East Africa, and specimens of the rubber furnished by the tree in these three countries have been examined at the Imperial Institute.

EAST AFRICA PROTECTORATE.

The discovery of *Mascarenhasia elastica* in the East Africa Protectorate was made in 1906 by Mr. E. Battiscombe, the Acting Conservator of Forests, who forwarded herbarium specimens of the plant to Kew, and a sample of the rubber to the Imperial Institute.

The tree is indigenous in parts of the forests of the Shimba Hills, to the south-west of Mombasa, and, as in German East Africa, it is usually found on the banks of streams or in moist situations. It here grows to a height of about 40 feet, and the trunk, which attains a diameter of about 18 inches, branches about 20 feet from the ground. The old trees have a thick, scaly bark, which can be easily removed; the inner bark is about ½ inch thick and can be easily cut, but the latex exudes slowly.

The value of *Mascarenhasia elastica* as a source of rubber in the East Africa Protectorate is not fully determined, but experiments on this point and on the suitability of the tree for cultivation are in progress. The trees are easily propagated from seed, which is produced freely, and they grow quickly, but they are not likely to succeed unless planted in moist valleys or on land bordering streams.

The specimen of rubber forwarded to the Imperial Institute by Mr. Battiscombe was a ball about 2¼ inches in diameter weighing 3½ oz.; it was formed of threads of rubber and contained a considerable amount of vegetable impurity. The rubber was light brown, and its physical properties were fairly satisfactory.

On analysis it was found to have the following composition:—

	Rubber as received.	Composition of dry rubber.
	Per cent.	*Per cent.*
Moisture	10·0	—
Caoutchouc	69·0	76·6
Resin	6·1	6·8
Proteid	3·5	3·9
Insoluble matter	11·4	12·7
Ash	2·29	2·54

These results show that the rubber would be of satisfactory composition, if it were not for the large amount of vegetable impurity included in it. This defect could, however, be easily remedied by careful collection.

The sample was valued at 3*s*. 6*d*. per lb. in London with fine hard Para at 5*s*. 2*d*. per lb.

PEMBA.

Early in 1909 Mr. R. N. Lyne, the Director of Agriculture in Zanzibar, forwarded to the Imperial Institute botanical specimens of a rubber-yielding tree which had been discovered in the Weti District of Pemba by Said bin Issa, the Arab Governor of Weti. A small specimen of the rubber obtained from the tree was also submitted. From the herbarium specimens the tree was identified at Kew as *Mascarenhasia elastica*, K. Schum., which

had not been previously recorded from Pemba. In response to a request for information concerning the occurrence of the tree in Pemba, Mr. Lyne has furnished the following particulars.

The tree is known locally as "Mkeko," "Mlimi" and "Mnamiaziwa," the last name meaning "there is plenty of milk." It is fairly widely distributed through Pemba, but has not yet been discovered in Zanzibar island. It attains a height of about 40 feet with a trunk one foot in diameter.

The natives had not recognised the possible value of the tree as a source of rubber, and large numbers of them have been cut down in making clearings. The tree appears, however, to possess considerable vitality, and shoots up quickly from the stump, even though cut back several times. The total number of *Mascarenhasia* trees in the island is not large, and many of them are little more than saplings, so that at present no considerable supply of rubber could be obtained from them. Experiments are, however, being made to determine the amount of rubber yielded by the trees and their suitability for cultivation, and should these trials prove successful the natives may be induced to plant the trees.

The sample of the rubber forwarded by Mr. Lyne consisted of six small balls together weighing 8½ oz. The balls were dark brown externally, but lighter and rather moist within when freshly cut; only a small amount of vegetable impurity was present. The rubber exhibited good elasticity and tenacity.

The results of the chemical examination are given in the following table:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	15·8	—
Caoutchouc	71·7	85·2
Resin	7·6	9·0
Proteid	3·1	3·7
Insoluble matter	1·8	2·1
Ash	1·09	1·29

The results of the analysis show that this specimen of *Mascarenhasia* rubber from Pemba is of good quality, although the percentage of resin is a little high. It is superior in composition to the sample from the East Africa Protectorate, as it contains

much less insoluble impurity, and the percentage of caoutchouc in the dry rubber is consequently higher.

The rubber was valued in London at 4*s.* per lb. with fine hard Para at 8*s.* 10*d.* per lb.

PORTUGUESE EAST AFRICA.

In 1907 Mr. W. H. Johnson, at that time Director of Agriculture in Mozambique, discovered in the neighbourhood of Beira a rubber-yielding plant which has since been determined as a variety of *Mascarenhasia elastica,* K. Schum. It differs from the type in having the leaves more obtuse and the follicles with more or less incurved tips. The plant is described as a shrubby tree from 20 to 30 feet in height, with bright dark-green leaves varying from 3 to 9 inches in length and from 1 to 2 inches in breadth. The trees are stated to be fairly abundant in several districts of the Mozambique Company's territories, and they are named "N'harasika" by the natives.

Two specimens of ball rubber and three of smoked sheet obtained from trees growing in Portuguese East Africa have been examined at the Imperial Institute.

Ball Rubber.

(1) "Probably a Mascarenhasia."

A single ball of brown rubber, which contained a fair amount of vegetable impurity. The rubber was slightly sticky, but otherwise exhibited satisfactory physical properties.

(2) "N'harasika rubber: collected from *Mascarenhasia elastica,* K. Schum. variety."

Three small balls of brown rubber, clean and free from stickiness. The rubber exhibited good elasticity and tenacity.

The results of the chemical examination of these two specimens were as follows:—

	Rubber as received.		Composition of dry rubber.	
	(1)	(2)	(1)	(2)
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	6·6	1·4	—	—
Caoutchouc	75·5	90·8	80·8	92·1
Resin	6·0	4·5	6·5	4·6
Proteid	3·4	2·4	3·6	2·4
Insoluble matter	8·5	0·9	9·1	0·9
Ash	3·2	1·9	3·4	2·0

It is evident from these figures that sample (2) is of very good quality, the dry material containing 92 per cent. of caoutchouc and only small amounts of resin, proteid and insoluble impurity. This specimen is in fact the best sample of *Mascarenhasia elastica* rubber which has been received at the Imperial Institute. A comparison of the results for samples (1) and (2) shows that the former is inferior in composition to the latter on account of the large proportion of insoluble matter present and the higher percentages of resin and proteid.

The samples were too small for trustworthy valuation, but it was thought that consignments of similar character would realise from 2*s.* 9*d.* to 3*s.* 3*d.* per lb. in London, according to quality, with fine hard Para at 3*s.* 11½*d.* per lb.

Smoked Sheet Rubber.

(*a*) A sheet of dark brown rubber, about ¼ inch thick, with a strong smoky odour; it was rather moist internally when cut. The rubber exhibited good elasticity and tenacity.

(*b*) A sheet of rubber very similar to (*a*), but rather moister and lighter in colour.

(*c*) A sheet of rubber similar to (*a*).

The results of the analysis of these three specimens are given in the following table:—

	Rubber as received.			Composition of dry rubber.		
	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	8·4	10·4	8·4	—	—	—
Caoutchouc	73·4	74·0	74·2	80·1	82·6	81·1
Resin	7·4	6·4	6·9	8·1	7·1	7·5
Proteid	3·6	3·4	3·5	3·9	3·8	3·8
Insoluble matter	7·2	5·8	7·0	7·9	6·5	7·6
Ash	1·8	1·6	1·8	1·9	1·8	1·9

It will be seen from these figures that the three specimens agree very closely in composition; the amount of caoutchouc in the dry material ranges from 80·1 to 82·6 per cent., whilst the percentages of the other constituents exhibit only slight variations. The amount of insoluble matter is rather high, although very little vegetable impurity was visible in the rubber.

The samples were valued at from 3*s.* 4*d.* to 3*s.* 9*d.* per lb. in London with fine hard Para quoted at 4*s.* 2½*d.* per lb.

CONCLUSIONS.

The results of the examination of these specimens of *Mascarenhasia elastica* rubber from the East Africa Protectorate, Pemba, and Portuguese East Africa, show that the product is of good quality if carefully collected. No definite information is, however, available regarding the average yield of rubber which the trees will furnish, so that it is not possible at present to state the probable value of the plant as a source of rubber. The experiments which are in progress in all three countries will determine this point and also the further question of the suitability of this East African rubber tree for cultivation in suitable localities.

GUMS FROM NORTHERN NIGERIA.

IN a previous article published in this *Bulletin* (1908, 6. 47), an account was given of the gum industry of Northern Nigeria, and the results of analyses of a number of samples of gum from that Protectorate were published. At the instance of the Imperial Institute a good deal of information has been collected during the last two years by political officers and others in the Protectorate, as to the distribution of gum-bearing acacias in Northern Nigeria, particularly in Bornu and Yola provinces, and it is now known with certainty that the gum is derived for the most part from trees of the same species as those yielding the well-known Sudan and Senegal gums, which constitute the bulk of the gum imported to this and other European countries. Samples of gums collected from some of the chief gum-yielding trees of Bornu, Yola and Sokoto provinces have also been received at the Imperial Institute, and these have been examined chemically, and in some cases have also been submitted to manufacturers for technical trial. The results obtained in the course of these various investigations are summarised in the following statement:—

BOTANICAL ORIGIN OF NIGERIAN GUM.

In a report on the flora and economic resources of Yola Province, Northern Nigeria, prepared by Dr. J. M. Dalziel, of which a copy has been supplied to the Imperial Institute by the Government of Northern Nigeria, the following information regarding the gum trees of that area is given.

"Gum, which is the predominating forest product of Bornu and of the Northern Hausa provinces, is also an important asset on the upper Bornu and its tributaries. Frequent attempts have been made to ascertain if possible exactly which species of tree yields each variety of gum sold to the European firms. Unfortunately the leather bag or calabash of a native gum collector in the bush generally contains pieces varying in colour and appearance which have been dislodged by means of a long stick or spear from any species of gum-yielding tree common in his district, and any sample may thus contain the products of several species. The culture of gum as carried on in the Anglo-Egyptian Sudan (*loc. cit.*) is entirely unknown in Nigeria, the collection being done at random at any time and in the most desultory fashion. Three varieties are recognised in trade under the following names: 'Falli,' 'Marrua' and 'Mumuye.' These are originally place names, and are not referable in any definite degree to gums of any single species of acacia or other genus. Falli is a place in the Gongola district, and the gum which arrives at the Niger Company's store at Nafada is chiefly of this variety. Thus, out of 1,500 cases received there this year, 1,300 were 'Falli.' In Yola, on the other hand, most of the gum received is 'Mumuye,' with a certain amount of 'Marrua' and less 'Falli.' Marrua is a district in German Adamawa, and Mumuye is the name of a pagan tribe near the Anglo-German boundary in Muri Province, but it must be said that samples of gum bearing these names are not necessarily gathered in these districts, which have in the course of trade operations afforded designations for different varieties of the article.

"In general, any white or nearly colourless gum is called 'Falli'; the tinted varieties, yellow or reddish, are classed as 'Marrua,' whilst 'Mumuye' gum is usually in lumps or masses of a dark smoky colour. 'Falli' and 'Marrua' gums are in

the form of large tears or pear-shaped pieces, lumps, broken fragments and occasionally pencils. Both give glassy fractures, but the surface of a piece of 'Falli' gum usually becomes finely fissured, with a loss of transparency, whilst 'Marrua' gum is a rule retains a glassy surface.

"As to the botanical sources of each of these varieties, one might suspect that 'Falli' gum is largely the product of *Acacia Senegal*, and this is doubtless true in part at least. This grey-barked acacia, the 'hashab' of Kordofan, is abundant enough in the northern provinces, though even there it is rarely more than a shrub or small tree. Its Hausa name is 'dakwora' (Fufulde, 'dibehi'); its gum is often almost colourless and is a known forest product exported from Bornu and the north as 'kolkol' gum, and it may possibly be the chief species supplying the 'Falli' gum to Nafada. In Yola Province, however, *Acacia Senegal* is much less abundant than in the north, and is usually an inconspicuous shrub, while the tree which the natives point to as the chief source of 'Falli' gum is the 'fara-kaya' (Hausa, 'white-thorn'), more rarely called 'bauji' in Hausa, and 'alluki' in Fufulde. This is a large acacia with a spreading crown of dark foliage, pale scaly bark, long white thorns and balls of white flowers. It is probably *Acacia Sieberiana*. Another species of acacia called 'karkara' in Hausa (Fufulde, 'fitarlahi'), apparently also known in Hausa as 'kumban shafu,' or 'parshin shafu,' also supplies gum which ranks as 'Falli.' This is a tall tree with light-coloured bark, spikes of white flowers, and branches armed with stout thorns, and is probably *Acacia Suma*. It is abundant in the north, and also on the Bornu road from Yola to Song, and is so far peculiar in habitat that one frequently finds it in small areas forming little groves by itself to the exclusion of most other species. The gum appears to be of an agreeable quality, as native carriers may often be seen sucking either the gum or pieces of the bark along with 'kanwa' or Bornu salt (see p. 404).

"'Marrua' appears to be properly the product of a single species which there is little doubt is *Acacia Seyal*, or the 'Falli' of the Sudan, though some of this gum may also be derived from *A. xanthophloea*. The former is known in Hausa as 'dussa,' and in Fufulde as 'bulbe' or 'fulbe,' and is a shrub or

small tree with yellow balls of flowers, narrow, curved and almost moniliform pods, and with the characteristic yellow or ochreous powder on the bark. It is common enough in Yola Province, as well as in the German colony, but not in such abundance as in some districts in the north, where the so-called 'mimosa bush' is in places largely composed of this species alone. Doubtless also gum from the 'gabbarua' (Fufulde, 'gabde'), *Acacia arabica*, and other species, and occasionally the less soluble gums from one or two species of *Albizzia*, which are nearly as common in the province as the acacia, may at times be mixed with samples of the better varieties.

"'Mumuye' gum, on the other hand, is derived from one or more species of *Combretum*, the usual source being *Combretum leonense*, a tree called in Hausa 'wiyan-demmu' or 'chiriri' (meaning 'neck of demmu,' the latter being *Varanus exanthematicus*, a large species of lizard, from the characteristic fissuring of the bark). The 'taramnia' or 'taraunia' (Fufulde, 'buski'), *Combretum verticillatum*, and probably other species of *Combretum*, *e.g.* the tree known as 'zindi' (? Hausa or Kanuri name), very similar to *C. Hartmannianum*, also supply this variety. Another of the *Combretaceae*, *Anogeissus leiocarpa* (Hausa, 'marike'; Fufulde, 'kojoli'), a tree with light, graceful foliage and balls of pale flowers, yields a gum some of which is probably sent as 'Mumuye,' and the well-known *Sterculia tomentosa* (Hausa, 'kukuki'; Fufulde, 'bobori'), yielding a sort of gum tragacanth, may also in some cases be similarly classed. The various species of the *Combretaceae* mentioned, are all particularly abundant throughout Yola Province, and gum classed as 'Mumuye' is procured quite as much from Kombo and Shillem on the river Gongola and elsewhere as from districts south of the Benue.

"Gum finds application by natives in many simple ways, *e.g.* in 'finishing' dyed cloth, preparation of Mallam's ink, compounding of sweatmeats and other comestibles, etc.

"Two other species yield gum which, so far as I am aware, is not collected by the natives in this province. One of these is the peculiar tree called 'Takanda giwa' (Elephant's sugar-cane), recently found at Kew to be a new species which has been named *Cussonia nigerica*, the leaves of which drop off during the dry season, giving the bare branches, with their somewhat

umbellate arrangement, the suggestive appearance expressed by its other designation, 'Hanun Kuturu,' or 'Leper's hand.' This exudes at wounded points a clear, colourless gum which hangs in slender pencils and appears to have some slightly irritant quality, as the tongue tingles a little when the gum is sucked.

"The other species, which has not been observed in the Hausa States, and for which it has proved impossible to ascertain a Hausa name, is called in Fufulde 'Tursuje,' and is a tree of about 15 to 20 feet at most, with pinnate leaves and pendulous racemes of plum-like, edible, acid fruit, turning red, purple or nearly black when ripe. It is Barter's blood-plum of Nupe (*Haematostaphis Barteri*). A piece of gum found on an injured tree of this species was clear and nearly colourless but readily became brittle and friable when dried. The bark of this tree is said to be used by the Fulani in Nassarawa as a remedy for sleeping sickness.

"The blood-red exudation of *Pterocarpus erinaceus* (Hausa, 'Madobia'; Fufulde, 'Yinyamhi,' or possessor of blood), is less esteemed by the natives than might be expected in a province where the species is particularly abundant. This tree, and another closely related species, not so far seen in other provinces, are chiefly valued for their excellent timber."

Dr. Dalziel's memorandum also furnishes the following information respecting some of the resin-yielding species which are only of interest in the present connection owing to the fact that their resinous exudations are sometimes found mixed with true gum (see page 363).

"*Daniella thurifera* (Hausa, 'Maje' and 'Kadaura'; Fufulde, 'Karlahi'), a tree which grows to a much greater size in the western and central parts of the Protectorate, such as Kontagora and Zaria, is not now tapped for its oleo-resin for purposes of trade. This product is used as frankincense either alone or in combination with other resins to fumigate and impart an agreeable scent to clothing and to improve the atmosphere in the houses of the better classes during the rains. Thus 'Karon Maje' (Illurin balsam), along with the odorous resin of two species of *Boswellia*, and the very fragrant tuberous root of the rush 'Kajiji' (*Juncus* sp.) abundantly cultivated

in Bornu, are burnt while the wearer holds his garments open over the fumes. The two species of Boswellia in question have been determined recently at Kew to be new and have been named *Boswellia Dalzielii* (Hausa, 'Hararabi' or 'Ararabi') and *B. odorata* (Hausa, 'Hanu'; Fufulde, 'Andakohi'). The shrub (*Balsamodendron africanum*) known as 'Dashi' (Fufulde, 'Badadeki') has a similar use, but in this case the whole bark is powdered and burnt. The above-mentioned species, though known all over N. Nigeria, are exceedingly abundant in Yola Province, and are frequently planted as a fence and support to the Zana matting enclosing the compounds in native towns."

Dr. Dalziel's interesting statement may be supplemented by information supplied by the Resident of Bornu Province, who states that in that province four trees yield gum of marketable quality, viz. "Karumga" (Arabic, "Talha"), "Kol-kol" (Arabic, "Harhass"), "Katalabu" and "Gulawai," these being Kanuri names. Herbarium specimens of three of these trees have been identified at Kew for the Imperial Institute as follows:—

"Kol-kol" = *Acacia Senegal*, Willd.
"Karumga" = *Acacia Seyal*, D.C.
"Katalabu" = *Acacia Sieberiana*, D.C. (probably).

EXAMINATION OF SAMPLES.

The method of examination employed for all these gums is that described in Part II of *Selected Reports from the Imperial Institute*, published as *Colonial Reports, Miscellaneous*, No. 63 [Cd. 4971] pp. 140–142.

GUMS FROM BORNU PROVINCE.

The following six samples were collected by the Resident of Bornu Province and were roughly graded under his supervision.

Description of Samples.

The samples included three grades of "Karumga" gum (derived from *Acacia Seyal*) and three of "Kol-kol" gum obtained from *Acacia Senegal*.

"*Karumga, large grade.*" Irregularly-shaped small fragments of gum, varying in colour from white to bright reddish-brown.

: interior of the fragments was generally vitreous and hard; the outer surface was often apparently opaque owing to ute superficial cracks. About three-quarters of the sample of the "glassy" type. The gum was almost completely ble in water, giving a brown, faintly acid solution. The esive power was good.

Karumga, medium grade." This gum closely resembled the eeding sample, and was in the form of small fragments and der varying from almost colourless to bright reddish-brown. ew fragments of bark were present. The gum was nearly pletely soluble in water, giving a brownish, faintly acid tion of good adhesive power.

Karumga, small grade." Very small fragments of mixed ı, varying from almost colourless to reddish-brown. Some he fragments had a burnt appearance and taste. The gum nearly completely soluble in water, giving a brown-coloured, :ly acid solution of good adhesive power.

Kol-kol, large grade." The sample consisted of mixed rs" and irregular fragments of gum. The "tears" were me cases 1¼ inch in diameter, but most were smaller. The ur of the sample varied, the larger pieces of gum especially g pale brown, and the remainder light coloured. The bulk e gum was of the "glassy" variety. The gum was almost pletely soluble in water, giving a clear, faintly acid solution ood adhesive power.

Kol-kol, medium grade." Small irregular fragments of y light-coloured gum, mixed with some more highly ured pieces. The fracture was hard and vitreous. The ple consisted mainly of the apparently opaque type of but contained about 25 per cent. of "glassy" pieces. gum was almost completely soluble in water, giving a -coloured, slightly acid solution of good adhesive power.

Kol-kol, small grade." Small irregularly shaped fragments granules of gum, mostly white with occasional coloured es. The sample consisted mainly of apparently opaque es, but a considerable quantity of "glassy" gum was ent. The gum was nearly completely soluble in water, ig a clear, light-coloured, faintly acid solution of good sive power.

Results of Examination.

	Moisture.	Ash.	Matter insoluble in water.	Relative viscosity of 10 per cent. solution at 22° C. as compared with 1 for water.
umga—	*Per cent.*	*Per cent.*	*Per cent.*	
Large grade . . .	11·42	2·66	1·41	6·66
Medium grade . .	11·27	2·57	0·84	5·86
Small grade . . .	11·19	2·50	1·30	5·96
kol—				
Large grade* . .	11·12	2.87	1·94	5.56
Medium grade* . .	11·48	2·99	1·54	6·66
Small grade* . .	10·24	3·17	1·20	5·36

These samples showed a specific rotation – 23°40′ *to* – 25°, *which is similar to found for Sudan gum from the same species.*

Commercial Valuation.

Karumga, large grade." This gum was valued at 30*s.* per . in London (January 1910). A firm of confectionery ıufacturers reported that the sample would not be of any for their purpose.

'he gum would be classed commercially as "sorts." Its uitability for use in confectionery is due to the presence of k-coloured fragments, which give a rather marked colour taste to mucilage made from it. On account, however, of relatively high viscosity and strong adhesive power of its ıtions it would be suitable for many other industrial poses.

Karumga, medium grade." This gum was valued at 19*s.* per . in London (January 1910). The manufacturers classed it h the preceding sample and stated that it was unfit for use in fectionery.

Karumga, small grade." This gum was valued at 19*s.* per . in London (January 1910). The confectionery manu-:urers reported that it gave a very dark solution, and was it for their purpose.

Kol-kol, large grade." This sample was valued at 24*s.* per . in London (January 1910). The confectionery manu-turers described it as similar to a good Galam (Senegal) n, and after technical trials they found that it was of ex-lent quality for use in confectionery, its colour and "strength"

being all that could be desired. For such purposes they therefore valued it higher than the succeeding sample.

"*Kol-kol, medium grade.*" This gum was valued at 27*s.* per cwt. in London (January 1910). The confectionery manufacturers described it as similar to a good Sudan gum. They tested it, and reported that it gave results not quite up to standard; it might, however, be used in confectionery.

"*Kol-kol, small grade.*" This sample was valued at 28*s.* per cwt. in London (January 1910). The confectionery manufacturers reported after technical trials that it could scarcely be used in confectionery, owing to the sourness and colour, which it developed during the tests, and if used, it would command for their purposes a lower price than dark Senegal gum.

This was a clean, light-coloured gum, but was in rather small pieces and granules, and for that reason it was valued at a lower price than the Karumga, large grade. Bold gum of this type, containing few granules and no dust, would, on the other hand, realise much higher prices than the Kol-kol medium and large grades of this series of samples.

SAMPLES FROM YOLA PROVINCE.

The botanical names inserted in the following descriptions are taken from Dr. Dalziel's memorandum quoted above, the native names in that memorandum which are phonetically similar to those supplied with these samples being taken as referring to the same species.

No. 1. "*Karakaia*" or Kumban Shahu (*Acacia Suma*) *gum from Shillem, Gongola, Yola Province.* The sample consisted almost entirely of one large "tear" of gum, containing a few pieces of bark and other extraneous matter embedded in it. The colour varied from pale yellow to dark reddish-brown. The gum was opaque on the surface, but "glassy" in the interior. The gum was almost completely soluble in water, giving a brownish, faintly acid solution of good adhesive power.

No. 2. "*Karakaia*" or Kumban Shahu (*Acacia Suma*) *gum from Song, Yola Province.* The sample consisted almost

entirely of one large "tear" of gum, closely resembling the preceding sample. A small proportion of "insoluble" gum was present, but most of the sample dissolved in water to form an almost colourless solution of good adhesive power.

No. 3. "*Farinkaia*" (*Acacia Sieberiana*) *gum from Dasin, Yola Province.* Broken fragments and masses of clear, light-brown gum, with some darker (red and dark-brown) and some lighter pieces. The gum was fairly hard and slightly "weathered." It had no taste or smell. The gum was practically completely soluble in water, and gave a clear, slightly coloured, very faintly acid solution of good adhesive power.

No. 4. "*Tolonia*" *gum from Shillem, Gongola, Yola Province.* The sample consisted of "tears" and broken pieces of gum weighing 10 to 15 grams each. They were clear and not "weathered"; some pieces were deep reddish-brown, others nearly white. The gum was hard and "glassy." It was nearly completely soluble in water, producing a reddish-purple, slightly acid solution of good adhesive power.

No. 5. "*Merki*" *gum* (*Anogeissus leiocarpa**) *from Mai Eni and Mai Faran, Yola Province.* Two irregularly shaped pieces of dull, faintly coloured, very hard gum, with some admixture of bark, leaves and other extraneous matter. The gum is of the "insoluble" class, swelling up completely on addition of water. With 10 grams of gum the insoluble granular appearance did not entirely disappear even when the dilution was carried to four litres.

No. 6. "*Kukuki*" (*Sterculia tomentosa**) *gum from Mai Eni and Mai Faran, Yola Province.* Small fragments of opaque white gum with adherent pieces of bark. The gum was hard and had an opaque fracture. It dissolved in water, forming a clear, white solution of good adhesive quality.

No. 7. "*Madobia*"* (*Pterocarpus erinaceus*) *gum from Shillem, Yola Province.* Broken "tears" and pieces of gum, mostly deep red in colour, but in some cases lighter. The fracture was clear and hard. The gum had an unpleasant, astringent taste. It dissolved in water, and produced a clear brown solution of fair adhesive power.

* See, however, note on page 362.

Results of Examination.

	Moisture.	Ash.	Matter insoluble in water.	Specific rotation at 18°C. in water.	Relative viscosity of 10 per cent. solution at 22°C. as compared with 1 for water.
	Per cent.	*Per cent.*	*Per cent.*		
No. 1. "Karakaia" gum from Shillem, Gongola, Yola Province . . .	13·56	2·00	4·50	−7° 18′	14·1
No. 2. "Karakaia" gum from Song, Yola Province .	13·32	2·36	4·10	−9° 6′	16·7
No. 3. "Farinkaia". gum from Dasin, Yola Province .	13·63	2·65	0·76	not determinable.	13·3
No. 4. "Tolonia" gum from Shillem, Gongola, Yola Province . . .	13·59	1·18	1·60	"	21·0
No. 5. "Merki" gum from Mai Eni and Mai Faran, Yola Province . .	17·08	6·63	—	—	—
No. 6. "Kukuki" gum from Mai Eni and Mai Faran, Yola Province . .	The sample was too small for detailed examination.				
No. 7. "Madobia" gum from Shillem, Yola Province .	12·01	2·14	1·67	—	13·5

Commercial Valuation.

These samples of gum from Yola Province were all too small for commercial valuation or technical trials. Nos. 1, 2, 3, and 6 are all promising gums, and further supplies of these have been asked for for trial. The gum of *Anogeissus leiocarpa*, No. 5, should be somewhat similar to Indian ghâti gum derived from *Anogeissus latifolia*, whilst that of *Sterculia tomentosa* (No. 6) should be a tragacanth-like gum, a description which in this instance applies to No. 5, but not to No. 6. It seems possible, therefore, that there may have been some confusion between these two samples in this case, and this is confirmed by the fact that, on hydrolysis by dilute sulphuric acid, No. 5 furnished 13·05 per cent. of acetic acid, which indicates fairly conclusively that it is a Sterculia gum. (Compare this *Bulletin*, 1910. 8. 21.)

Further, "Madobia" gum is said to be derived from *Ptero-*

carpus erinaceus, which might be expected to yield a kino rather than a true gum. The present sample of "Madobia," though possessing a slightly astringent taste had nothing in common with kino.

GUMS FROM SOKOTO PROVINCE.

The following samples were collected by the Resident of Sokoto Province.

Description of Samples.

"*Farinkaia*" (*Acacia Sieberiana*). The sample consisted of "tears," masses, and very small fragments of gum, varying in colour from pale yellow to dark brown. The fracture was generally transparent and vitreous. A considerable quantity of "burnt" gum, dirt and bark was present in the sample. The gum yielded a dark brown mucilage, which was almost tasteless but possessed a slight odour.

"*Chiriri*" (*Combretum* sp., ? *leonense*). The sample consisted of "tears," long pieces and fragments of gum varying in colour from yellow to dark brown. The fracture was transparent and vitreous. A considerable quantity of foreign matter, chiefly bark and leaves, was present. The gum yielded a dark brown mucilage, possessing a very slight odour and no taste.

"*Karo*" (*Acacia Suma*). The sample consisted of "tears," masses and fragments of gum varying in colour from pale yellow to pale brown. The fracture was transparent and vitreous. A very small quantity of foreign matter, chiefly bark and leaves, was present. The gum yielded a light yellowish-brown mucilage, almost tasteless, and possessing a very slight odour.

The products sent also included samples of materials labelled as follows: "Dashi" (*Balsamodendron africanum*), "Dundu," (*Dichrostachys nutans*), "Taura" (*Detarium senegalense*), "Madauchi" (*Khaya senegalensis*), "Taramnia" (*Combretum verticillatum*), and "Maje" (*Daniella thurifera*). These six products were in most cases not uniform materials, but consisted of mixtures of gum and resin, and were unsuitable for investigation.

Results of Examination.

	Moisture.	Ash.	Matter insoluble in water.	Specific rotation at 22° C in water.	Relative viscosity of 10 per cent. solution at 22° C. as compared with 1 for water.
	Per cent.	*Per cent.*	*Per cent.*		
"Farinkaia" *	13·4	2·9	3·1	not determined	6·7
"Chiriri"	12·9	2·0	1·2	"	7·8
"Karo"	13·8	2·4	1·2	"	5·5

* *The figures for this gum are probably abnormal owing to the presence of "burnt" gum in the sample.*

Valuation of Samples.

Farinkaia. This gum was valued at 18*s.* per cwt. in London (October 1910).

Chiriri. The sample was considered to be hardly worth importing into the United Kingdom, being at most worth only 12*s.* per cwt. in London (October 1910).

Karo. The material was valued at 23*s.* to 24*s.* per cwt. in London (October 1910).

GENERAL CONCLUSIONS.

The results of these investigations, though they still leave uncertain the precise value and botanical origin of certain of the less important gums found in Northern Nigeria, yet are of considerable importance in establishing that in Bornu and Yola the principal sources of gum, viz. *Acacia Senegal*, *A. Seyal*, and *A. Sieberiana* are the same species that yield the important commercial gums of the Anglo-Egyptian Sudan and of Senegal. Moreover, it is satisfactory to find that in the chief gum-collecting centres the same species of Acacia often occurs alone over wide areas, so that it is probably not impossible in Bornu at least to ensure that the gum collected is almost entirely from a single species, and by educating native collectors on this point much could be accomplished in avoiding variability in the quality of Nigerian gum as exported. The importance of this will be obvious from the following table, which summarises the results already given, and shows the variation in properties exhibited by gums from different species.

Source of gum.	Moisture per cent.	Ash per cent.	Matter insoluble in water per cent.	Strength as measured by viscosity.	Colour of mucilage.
Bornu Province.					
Acacia Senegal . .	10·24 to 11·48	2·87 to 3·17	1·20 to 1·94	5·36 to 6·66	Almost colourless to pale brown.
Acacia Seyal . . .	11·19 to 11·42	2·50 to 2·66	0·84 to 1·41	5·86 to 6·66	Brown.
Yola Province.					
Acacia Suma . .	13·32 to 13·56	2·00 to 2·36	4·10 to 4·50	14·1 to 16·7	Colourless to brown.
Acacia Sieberiana .	13·63	2·65	0·76	13·3	Pale coloured.
Sokoto Province.					
Combretum sp. . .	12·9	2·0	1·2	7·8	Dark brown.

It is clear that if mixed gum is exported it is liable to vary greatly in different consignments depending on the relative proportions of gums from different species present, and in this respect the best gum of the Anglo-Egyptian Sudan has the great advantage from a commercial point of view of being collected from plantations consisting of a single species, *Acacia Senegal*, the inferior varieties only, as a rule, consisting of mixed gums.

The important questions of cleaning gum free from vegetable impurities such as fragments of leaves, bark, wood, etc., has been dealt with in the previous article (*loc. cit.*), and need not be insisted on again, and this also applies to the equally important matter of grading gum into qualities consisting of pieces of about the same colour and size.

COFFEE FROM THE EAST AFRICA PROTECTORATE AND RHODESIA.

SAMPLES FROM THE EAST AFRICA PROTECTORATE.

Two small samples of coffee grown in the East Africa Protectorate were forwarded for examination to the Imperial Institute by the Director of Agriculture in May 1909.

Description.

The specimen labelled "Native No. 13" consisted of evenly-coloured, dull green beans of rather irregular size. The parchment skins, which had not been removed, were of a dull stone colour, and formed 14·4 per cent. by weight of the sample.

The specimen labelled "Plantation No. 14" consisted of evenly-coloured, dull olive-green beans of irregular size and shape, but generally larger than those of sample No. 13. The parchment skins were of dull brownish-cream colour and formed 22·2 per cent. by weight of the sample.

Results of Examination.

A chemical examination of the beans, after removal of the parchment skins, gave the following results:—

	No. 13. "Native." *Per cent.*	No. 14. "Plantation." *Per cent.*
Moisture	10·86	10·71
Caffeine (in the beans as received)	0·49	1·15

The relative average size and weight of the beans is indicated by the following comparison:—

Number of beans required to fill a 50 cc. measure . .	415	297
Weight of ditto	32·8 grams	32·03 grams
Average weight of single bean	0·079 "	0·108 "

Conclusions.

Coffee usually contains about 1·2 per cent. of caffeine, so that sample No. 14 is of normal composition in this respect.

Sample No. 13 contains a low percentage of caffeine, and for that reason it might, if its flavour after roasting is satisfactory, commend itself to those who are advised to use coffee containing little or no caffeine.

The samples originally received were too small for commercial valuation, since for this purpose it is desirable to make roasting trials with the coffee, and larger supplies were asked for.

In response to this request additional samples of the coffees were received in November 1909 from the Director of Agriculture.

The "plantation" coffee was very similar in appearance to the small sample originally received. The new sample of

"native" coffee was, however, inferior to the first small specimen; it consisted largely of dark-coloured, small or shrivelled beans, and was somewhat unsatisfactory in appearance.

Portions of these large samples were submitted to commercial experts who valued the "plantation" coffee at 54*s.* per cwt., and the "native" coffee at 41*s.* 6*d.* per cwt. (December 1909). The experts further stated that these coffees would command a ready sale in this country. It is possible that the price quoted for the "native" coffee is rather lower than would be obtained for a sample of as good appearance as the first small specimen of this variety which was submitted.

SAMPLES FROM RHODESIA.

These samples were forwarded for examination to the Imperial Institute in April 1910. They were all grown in the Melsetter District, and the following additional particulars regarding them and the soils on which they were grown were furnished.

(1) Second crop, from healthy trees; plucked August 1908. Grey, fertile, fine sand; old bush ground.
(2) Grown on dark-red friable sand, derived from dolerite.
(3) Grown on rich grey sand; old bush ground.
(4) Grown on rich red loam on a steep slope with south aspect; on the northern limit of the coffee-growing area.
(5) Grown on rich, red, deep, doleritic soil in bush ground.
(6) Grown on rich doleritic loam at an altitude much higher than most coffee plantations, viz. 4,700 feet; 40 miles north of the recognised coffee-growing area. Trees under two years of age.
(7) Grown on light sandy loam one foot deep with a stiffer subsoil. South-west aspect.
(8) Grown on red sandy loam, originally grass veldt.
(9) Grown on light loam, formerly grass veldt.
(10) Grown on rich, red, sandy loam.
(11) No details supplied.

The following table indicates the characters of the samples as compared with average commercial samples of Mysore and Brazilian coffees:—

Results of Examination.

No. of Sample.	Colour.	Number of beans to fill a 100 cc. measure.	Weight of 200 beans. *Grams.*	Broken beans present in sample. *Per cent.*	Remarks.
1.	Dull olive-green	660	25	10	Free from pulp and foreign matter.
2.	Dirty green . .	630	25	6	A small amount of foreign matter, chiefly pieces of husk, was present. The sample was free from pulp.
3.	Light greyish-green	762	21	18	Free from pulp and dirt.
4.	Brownish grey-green	691	24·5	14	do.
5.	Dull greyish-green	591	28	7	do.
7.	Pale brownish-green	646	25·5	10	do.
8.	Dirty pale olive-green	621	26·5	14	do.
9.	Dull pale olive-green	664	25	14	do.
10.	Dirty olive-green	566	30	3½	Free from pulp but contained a large amount of broken leaves, bark, twigs, etc.
11.	Pale brownish-green	694	24	12	Free from pulp and dirt.
Mysore I.	Dirty olive-green	475	37·5	nil	do.
,, II.	Dirty olive-green	456	37·5	nil	do.
Brazil (Santos): Ordinary	Brownish-green .	718	22·5	7	do.

Commercial Valuation.

The samples were submitted to a firm of commercial experts who valued them as follows (May 1910):—

No. 1.	47*s.* per cwt.	No. 7.	44*s.* per cwt.
No. 2.	43*s.* to 44*s.* ,,	No. 8.	46*s.* ,,
No. 3.	42*s.* to 43*s.* ,,	No. 9.	45*s.* to 46*s.* ,,
No. 4.	48*s.* ,,	No. 10.	35*s.* to 37*s.* ,,
No. 5.	45*s.* ,,	No. 11.	42*s.* ,,

The prices of the commercial coffees with which these samples were compared, were on the same date—

Mysore I, 75*s.*, and Mysore II, 78*s.* per cwt.;
Brazil (Santos) ordinary, 35*s.* per cwt.

The brokers added that the prices quoted for the Rhodesian samples were such as would be realised for fair quantities of coffee and not for small lots.

These Rhodesian coffees were all of promising quality; they were prepared by hand and for that reason contained a rather large proportion of broken beans. As soon as the industry is large enough to warrant the introduction on a considerable scale of machinery for pulping, cleaning and grading the coffee beans, a product which will realise much better prices than these now quoted will doubtless be obtainable, since the coffee itself appears to be of very good quality.

MAIZE FROM NYASALAND AND THE GAMBIA.

THIS Nyasaland maize was forwarded for examination to the Imperial Institute by the Director of Agriculture at Zomba in August 1909, and was described as native-grown maize from the Port Herald District.

The sample consisted of fairly clean, very pale yellow maize, with here and there a darker-coloured grain. Some of the grains showed signs of attack by weevils.

The maize was submitted to a firm of grain merchants, who reported that it was of the round white variety and of excellent quality. They valued it at about 25*s.* per quarter in London (November 1909), but intimated that higher prices would be realised by consignments containing no damaged grain.

SAMPLES FROM THE GAMBIA.

Two samples of maize (white and yellow) were forwarded to the Imperial Institute from the Gambia in January 1910. It was stated that the white maize was grown from Lagos seed, and the yellow maize from seed obtained from Grand Canary. The natives prefer the latter variety as it grows more quickly and is more prolific.

Description of Samples.

1. *White Maize from Lagos seed.* This consisted of clean, well-prepared grain, almost white but with a faint tinge of

yellow. The maize was in very good condition and free from shrivelled or damaged grains.

2. *Yellow Maize from Grand Canary seed.* This consisted of maize of deep orange colour with occasional red grains. It was not in quite such good condition as the white sample No. 1, a few of the grains being weevilled and others rather small and shrivelled.

Commercial Valuation.

The samples were submitted for valuation to brokers and to grain merchants, whose reports are summarised below:—

White Maize. The brokers described this as a fine sample, of good colour, worth 5*s.* 6½*d.* per cental of 100 lb. (February 1910), and stated that such maize would be readily saleable in the Liverpool market.

The merchants reported that the quality was very good, and that such maize free from weevils would always command a fair price in competition with grain from other countries. They valued it at about 25*s.* 6*d.* per quarter of 480 lb., c.i.f. London (March 1910).

Yellow Maize. This was described by the brokers as a useful corn for grinding, although its deep colour would be a disadvantage. It would however be readily saleable in Liverpool at a similar price to the white maize, viz. 5*s.* 6½*d.* per cental of 100 lb. (February 1910).

The merchants stated that on account of damaged and weevilled grains this sample of yellow maize was below the white maize in quality, and they valued it at 23*s.* 6*d* to 24*s.* per quarter of 480 lb., c.i.f. London (March 1910).

It is evident from the reports of the commercial experts that both these varieties of maize would find a ready sale in the United Kingdom, provided care is taken to ship them in good condition and as free as possible from weevilled or damaged grains.

For general information regarding the cultivation of maize and its preparation for the market, the article in this *Bulletin* (1908, 6. 261) should be consulted.

LAC RESIN FROM BARODA, INDIA.

THE samples of lac which are the subject of this report were forwarded to the Imperial Institute by the Superintendent of the State Gardens at Baroda in June 1909. They were described as having been collected from the *Inga Saman* (*Pithecolobium Saman*) or "rain tree," which it was stated had only recently been used as a host for the lac insect.

Description of Samples.

(1) *Stick lac.* Broken twigs and small branches, covered, in some cases very incompletely, with lac incrustation. The percentage of actual resin present was 16·8.

(2) *Seed lac.* Granular lac as removed from twigs, mixed to a certain extent with small fragments of wood and bark, together with some amount of dust.

Results of Examination.

The following results were obtained on analysis:—

	Lac resin removed from stick lac. (*Sample No.* 1.) *Per cent.*	Seed lac resin as received. (*Sample No.* 2.) *Per cent.*
Moisture	2·8	2·7
Ash	1·4	2·2
Wax	9·0	6·6
Colouring matter	7·2	12·4
Insoluble „	8·1	8·6
Resin	71·5	67·5
Iodine number:—		
Before purification	5·6	4·5
After purification from dust, etc.	4·0	3·9

Very few analyses of lac resin have been published with which these results may be compared, but comparison with authentic samples of lac in the collections of the Imperial Institute showed that the Baroda resin was of fair average quality.

Commercial Valuation.

The stick lac as sent would not pay for export to Europe owing to the small quantity of lac present as compared with the wood, but the seed lac was submitted to commercial experts for

valuation. They reported that it would be worth from 55*s.* to 60*s.* per cwt. in London (April 1910), and expressed the opinion that it would meet with a ready sale.

For general information on the production and uses of lac this *Bulletin* (1909, 7. 63) should be consulted.

GENERAL NOTICES RESPECTING ECONOMIC PRODUCTS AND THEIR DEVELOPMENT.

COTTON AND RUBBER IN NYASALAND.

THE report of the Director of Agriculture in Nyasaland for 1909–1910 has now been issued, and a brief reference to its contents has been made already in this *Bulletin* (1910, 8. 294). The portions of the report relating to cotton and rubber are of special interest, and contain information likely to be of great value to those interested in the cultivation of these two materials, and they are therefore reprinted here in a slightly condensed form.

COTTON.

The cotton area under European management has increased from 6,037 acres in 1908 to 8,975 for the year under review, and the crop at present being harvested covers over 12,000 acres. These figures show that progress is being made, and fortunately the quality of the cotton is also satisfactory, as much as 1*s.* 2½*d.* per lb. having been obtained for Nyasaland-Upland cotton in 1909. Nyasaland-Upland cotton is now thoroughly acclimatised and does well at heights from 1,000 to 3,000 feet, which is a remarkably wide range for a single variety. On the lower levels the growing season is longer and the yield generally heavier, but the cotton obtained is inferior to that grown in the Highlands, being less silky. Lustre, silkiness and good length of staple seem to be inherent characters of cotton grown on the Highland soils, and all classes of cotton acquire these characters after being grown for a few years in the country. The yield per acre is also increasing, and several estates which produced 100 lb. of lint per acre a few years ago are now averaging as high as 165 lb., whilst some have furnished over 2 cwt. per acre.

The European Egyptian crop of the Lower River was a partial failure due to the ravages of "bacterial blight," a disease of American origin, which has been the cause of considerable loss for several years past. During last season careful investigations into the cause of this disease on river-grown Egyptian cotton were carried out, and the following conclusions arrived at:—

1. The disease was most severe in low-lying portions of estates at or below the level of high river.

2. From the wet lands it spread to the better-drained soils.

3. Late-sown cotton proved less liable to attack by blight.

4. Nyasaland-Upland was practically disease-resistant, even when grown in wet situations.

Putting into practice the information obtained, owners of plantations on the river were advised to plant Nyasaland-Upland cotton in low-lying portions of their estates, and Egyptian cotton where soil aëration and drainage were satisfactory. This advice was generally acted on, and in one district this year there are nearly 1,000 acres of healthy Nyasaland-Upland cotton in place of the same area of dead or dying Egyptian cotton. The crop of Egyptian cotton in Nyasaland, although small, was sold at prices which compared favourably with those obtained for Egyptian-grown cotton, and now that the problem of blight has been solved, it is hoped that the quality of the crop will improve in future, as there is a considerable shortage of this class of cotton on the market.

Native Cotton Industry.

The extension of the native cotton industry is of necessity a slow process, but it seems likely that in a few years native-grown cotton will form the largest export of the Protectorate.

The future prosperity of Nyasaland as an agricultural country depends principally on the development of native agriculture, and no crop is more suitable than cotton for this purpose. Since the introduction of native cotton cultivation by the Government it has steadily progressed, and the crop for the year under review amounted to 220 tons, an increase of 130 tons on that of the previous year. The crop now approaching maturity is promising, and as the distribution of seed was practically twice as great as that of last year it is anticipated there will be as large an

additional increase as in the past season. The quality of the native-grown Nyasaland-Upland cotton has always been as good if not better than the European grown, but the native crop of Egyptian cotton has generally been very disappointing, being largely composed of mixed staple. Last season a marked improvement was brought about by teaching the natives how to grade their cotton, and a large quantity of Port Herald native-grown cotton obtained 1*s.* 1*d.* per lb., one of the highest prices obtained for Egyptian cotton grown in the Protectorate. The greatest difficulty encountered is in inducing natives to thin their seedlings to two plants at most; they always wish to leave from 6 to 10 plants at one place, as with maize, thinking the larger number of plants will give the heavier yield.

One of the greatest drawbacks to progress in the native cotton industry is the distance between some of the cotton fields and the ginneries, and it is therefore satisfactory to find that the British Cotton Growing Association is establishing a ginnery at Port Herald in the largest native-cotton centre of the Protectorate, and it is hoped that another will be erected near Lake Nyasa to gin the cotton produced there.

SELECTION EXPERIMENTS WITH NYASALAND-UPLAND COTTON.

The class of Upland cotton grown in the Shiré Highlands would be known in the United States as "Florodora" or "Long-staple Upland" and is similar to the cotton of the Mississippi Valley. There is no record of the name of the variety or varieties of Upland cotton first imported to Nyasaland in 1905, and judging from the present appearance of cotton fields in the Protectorate inter-variety fertilisation has taken place. When Upland cotton was first introduced, the main crop of Nyasaland was Egyptian cotton, and judging from the characters exhibited by some plants there is also a considerable percentage of hybrid Abassi-Upland. This view receives support from the fact that on several occasions Nyasaland-Upland has been classed and sold by brokers in the United Kingdom as Abassi.

In order to start selection experiments, the Agricultural Department secured samples of the prize cottons exhibited at the Blantyre Agricultural Show in 1908–09, where a representa-

tive collection of over forty samples of the best estate-grown cottons of the Protectorate was exhibited. This Nyasaland-Upland seed was mixed before sowing, and systematic selection was commenced towards the end of 1908 and continued during the year under review. Before commencing this work, most of the estates in the Shiré Highlands were visited, and the characters of the cotton plants studied and compared with the general characters of long-staple Upland cotton of the Mississippi Valley.

The characters of the unselected crop may be grouped as follows:—

Vegetative Characters.

Most of the plants resembled typical long-staple Upland cotton in leaf and stem, but a small number had deeper and more pointed leaves with practically hairless stems, indicating Egyptian origin. The branching character and growth of the crop was most irregular, but the following types were predominant:—

(1) Tall, scarcely-branched plants.
(2) Tall plants with wide open branches resembling Egyptian cotton.
(3) Typical short, evenly-branched Upland types with the branches leaving the main stem at regular intervals and slightly ascending from it.

In Nyasaland, where the growing season is short, the branching character of the plants has a great influence on the ripening of the crop, and therefore the yield per acre depends in no small degree on the type of plant grown. It is necessary, therefore, to take advantage of every character that leads to early ripening, and the heaviest yields are obtained from plants which, though carrying many fruiting lateral branches, arranged round the main stem in such a manner as to allow the maximum amount of sunlight to reach the entire plant, yet do not unduly shade their neighbours or obstruct the necessary tillage operations. Plants with very long horizontal or prostrate lower branches should be avoided, as they interfere with cultivation; if they are fruiting branches the lower bolls open late and the cotton is liable to be stained by the soil; if they are purely vegetative

branches they receive insufficient light for maximum assimilation. Plants with dense upper foliage should also be avoided, as they generally shed a large percentage of their lower bolls.

It might be thought possible to obtain as good a yield from a few large plants as from a greater number of smaller plants; this may be true in a country with a very long growing season, but in Nyasaland the season is too short to mature large plants. In the experiments so far made the Director finds that branching character is to a great extent handed on from parent to offspring and is not influenced by the nature of the soil. Thus plants of the same parentage grown on sand and clay soils showed similar modes of branching, although the plants on the sand were only half as high as those on clay. Once a type is selected from acclimatised seed, branching character remains practically constant in the offspring of Upland cottons. Egyptian cotton is generally much more influenced by change in climate than Upland cotton, especially as regards branching character; the decreasing crop from Nyasaland-grown Egyptian seed is attributed in large measure to the increasing percentage of tall, scarcely-branched plants; in practice cultivators of Egyptian cotton in Nyasaland prefer newly-imported seed. If Egyptian cotton were carefully selected, after being grown in Nyasaland for a few years, it is believed that it would give better results than newly-imported seed, and confirm experience in the United States, where the crop was at first pronounced a failure, but where, after five years' selection, Abassi cotton gave a yield of 460 lb. of lint per acre.

Any planter growing Egyptian cotton from newly-imported seed should compare it with his crop grown from unselected partially-acclimatised seed, and he will notice the larger percentage of undesirable types in the latter, and recognise the need for systematic selection.

An ideal plant of Nyasaland-Upland cotton should exhibit the following vegetative characters:—

(1) Medium height.
(2) Strong central stem with short internodes.
(3) Lateral branches arranged evenly round the central stem and slightly ascending from it.

It is impossible to suggest a fixed distance for planting, as size of plant is influenced by soil, but on average soil the ridges should be 4 feet apart, and there should be a distance of 20 to 24 inches between two consecutive plants.

Reproductive Characters.

The shape of the flower varies from the short-petalled, wide-open flower characteristic of Upland cotton to the long tubular contorted flower of the Egyptian plant. In colour the great majority are white, but generally the long flowers are very pale yellow with or without faint red markings towards the base of the petals inside. Plants with such flowers are generally less hirsute than the ordinary Upland type, and carry more pointed bolls of a darker green colour, and are sometimes three chambered, as in Egyptian cotton. The bolls are of three kinds, viz. *short round bolls*, characteristic of most short-staple Upland cotton; *more pointed bolls*, characteristic of long-staple Upland, and *very pointed three-chambered bolls*, as already described. There is as a whole a marked tendency towards long pointed bolls, much more so than in the Mississippi cotton fields. The seeds are as a rule covered with dense fuzz, but a small percentage is partially naked, like Egyptian ; a noteworthy fact is that naked seed is never found on plants with round bolls, and that a considerable percentage of such seed is sterile or immature. The lint on the whole is better than American long-stapled Upland, and during the past year was valued as high as 1*s.* 2½*d.* per lb. and reported by experts to be the best Upland cotton ever imported into the United Kingdom. A careful examination of lints from various types of trees showed that some of the cotton was as good as Abassi, and probably this cotton was responsible for the high valuation of the general crop; certainly the cotton from the round bolls was inferior to ordinary Mississippi cotton.

There is a relationship between shape of boll and quality of lint, the cotton from pointed bolls being longer and silkier than cotton from round bolls. After examining samples from many estates in the Shiré Highlands it was found that the most general fault in Nyasaland-Upland cotton was weakness of staple, and therefore strength was considered a most important qualification in selecting plants, and all plants when tested for

lint percentage were discarded if they yielded weak fibre. The experiment has not been carried far enough to ascertain whether strength of lint is a hereditary character; but experience so far seems to indicate that there is a close connection between nature of soil and strength of lint; the heavier soils generally producing the stronger cotton. The heavy dark soil in the vicinity of Chiradzulu produced the strongest cotton in Nyasaland last year. Light soils produce harsher and more brittle cottons than clay soils, possibly due to fluctuating soil temperature and the greater transpiration of plants growing in sand.

The determinations of the lint percentages and of the quality of the lint were conducted in the laboratory. Lint percentage is a most important consideration in a country where there is practically no sale for cotton seed. In order to ascertain the normal lint percentage in the unselected crop, samples from different localities were tested, and the results pointed to 27 per cent. as being the usual lint yield of unselected Nyasaland-Upland seed cotton. Twenty-seven per cent. is low, and the following figures show the lint percentages of ninety-one plants which passed the lint tests in the laboratory out of 225 plants originally selected in the field in the first year:—

Mean lint percentage	33·58
Maximum „	41·00
Minimum „	28·70

In determining lint percentage it is necessary to examine the seed for soundness, as the presence of light, dead seeds unduly raises the lint percentage. It is also advisable, for future reference and comparison, to place in a separate numbered envelope a sample of each lint which passes the laboratory test; this number should be the same as the number of the line of plants grown from the seed during the second year of the experiment.

METHOD OF SELECTION RECOMMENDED.

First Year in Field.

(1) A collection of the best seed procurable should be obtained.

(2) Selection should not be started until the cotton is nearly ready for harvesting, as a considerable percentage of

the plants turn red with cold, and do not mature their cotton.

(3) A type should be selected which allows receipt of the maximum amount of sunlight and resembles as nearly as possible the ideal plant already described.

(4) Plants with pointed bolls should be preferred, as the staple is generally longer.

(5) Early maturity should be taken into consideration, as bolls which open late generally produce inferior cotton.

(6) Each plant should be marked separately, and harvested separately, the seed cotton being placed in bags attached to the plant.

It is necessary to mark a larger number of plants than is actually required, as it is improbable that more than 50 per cent. will pass the laboratory tests of the first year, not to mention subsequent losses through rejection of types which do not exhibit fixity of character.

First Year in Laboratory.

(1) All bags with weak cotton should be discarded, as this is the principal failing in Nyasaland-Upland cotton.

(2) The lint percentage should be determined, and all samples yielding less than 30 per cent. discarded, unless they have special qualities.

(3) No sample whose fibre is less than 1·25 inches in length should be retained.

(4) Silkiness and lustre should be considered, and samples showing dulness and harshness of fibre discarded.

(5) A sample of lint from the cotton of each tree which has passed the laboratory tests, should be placed in a numbered envelope. The lint percentage should be marked outside, and the sample filed for future experiment. The same number should be used as a field number for the seed from the sample in the second year of experiment.

Second Year in Field.

(1) The seed from each bag should be planted in a separate ridge, the ridges being arranged according to lint percentage.

(2) Notes should be made regarding germination, general progress and period of ripening.

(3) All plants which do not come true to the selected type, also weakly plants, or any plants which exhibit signs of weakness at the commencement of the cold season (April) should be uprooted.

(4) Each line should be harvested separately and the seed cotton placed in a bag numbered to correspond with the laboratory sample.

Second Year in Laboratory.

(1) An average sample of each cotton should be compared with the correspondingly numbered sample of the previous year.

(2) All samples which fall below a lint percentage of 30 or exhibit undesirable qualities should be discarded.

(3) A further sample should be taken for reference, and given the same number as the corresponding sample of the first year, but "2" added to indicate that it is from the second year's crop.

Third Year.

(1) The seed from each line should be sown separately in acre plots.

(2) Undesirable plants should be uprooted.

(3) Each acre should be harvested separately.

(4) All the cottons from acre plots which pass laboratory tests may be mixed for next season's general selected crop.

Fourth Year.

Selection from individual plants should be made as in the first year, using the general selected crop for the purpose.

The above process entails a considerable amount of work, and probably more than the ordinary planter has time to undertake, but it is believed that the best results will only be attained by keeping separate for at least three years the offspring of a single individual. When many plants are included together in line tests, uniformity of type is practically impossible to attain, as important individual characters become overlooked when uprooting undesirable plants. The highest standard of perfection

can only be attained by careful work from the individual plant; the special advantage of such a procedure lies in the fact that the type preponderates in the experimental lines, and, should any line exhibit undesirable characters as a whole, it may be rejected. The family likeness in Upland cottons of acclimatised common parentage is remarkable; so marked is this in the field lines that a novice can distinguish where the offspring of one plant ceases and that of the next commences.

RUBBER.

It has been conclusively proved that the rainfall of the Shiré Highlands is not sufficient for the Para rubber tree, and the only district thus far found suitable for this species is West Nyasa, where one estate of 600 acres is doing well. The Ceará rubber tree grows better in Nyasaland than any other rubber plant, and the area under this variety has steadily risen to 4,403 acres; but unfortunately a large proportion has been planted in exhausted coffee gardens. The most promising Ceará rubber estates in the Shiré Highlands are situated at Michiru, near Blantyre, and the table on p. 382 gives figures relating to an interesting tapping experiment conducted by Mr. F. C. Hayter on four-year-old Ceará rubber trees growing there.

Tapping was commenced on March 4, 1910, and continued to April 6, 1910. The trees were under experiment for twenty-two days, and during this period the results on four days were spoilt by wet weather, while on several days on which tapping work would otherwise have been continued it was suspended on account of rain, which coagulates the Ceará latex and prevents the flow. In these experiments the trees have given 1 oz. of dry rubber per tree in *two tappings only per tree.* The cost of collecting the rubber works out at about 4*d.* per lb. of dry rubber, excluding the cost of European supervision. The bulk of the rubber collected was made into biscuits or sheets; a small proportion of scrap was also included which was picked off the trees. The biscuits were put through a wringer about ten times, and, after practically every drop of water had been expelled, they were weighed, the product being reckoned as wet rubber. It was found that biscuits treated in this manner lost one-third

of their weight in becoming dry, transparent and suitable for the market.

Results of Experimental Tapping of Four-Year-Old Ceará Trees.—(Manihot Glaziovii.)

Date, 1910.	Number of Natives Employed.	Number of Children Employed.	Yield of Wet Rubber. Ounces.
March 4	2	—	6
,, 5	1	6	22½
,, 7	2	—	13
,, 8	2	3	44½
,, 9	1	1	13¼ (Rain)
,, 10	2	3	34
,, 11	2	—	12 (Rain)
,, 14	2	4	37
,, 15	2	2	34½
,, 16	2	—	27 (Rain)
,, 20	2	—	36
,, 21	2	2	31
,, 22	2	—	14½ (Rain)
,, 24	2	—	38
,, 25	2	—	46
,, 28	2	1	39½
,, 29	2	—	44½
,, 31	2	—	20
April 1	2	—	26
,, 4	2	—	20
,, 5	2	—	21
,, 6	2	—	17½
TOTALS	42 at 2*d.* a day = 7/-	22 at 1*d.* a day = 1/10	597¾ or 398 dry

The trees were planted 15 ft. × 9 ft. and 12 ft. × 9 ft., and the majority of those tapped varied between 12 and 19 inches in girth at 3 feet from the base. The total number of trees tapped was 443, of which 170 had a girth under 12 inches at 3 feet from the base. The 170 trees under 12 inches girth yielded 42 oz. of dry rubber, or approximately ¼ oz. each; this amount deducted from the total of 398 oz. gives a total yield of 356 oz. dry rubber, from the 273 trees with a girth of over 12 inches or approximately 1⅓ oz. per tree. The system of tapping employed in the Michiru experiment may be described as a series of vertical rows composed of numerous semi-horizontal incisions about 1 inch apart. The actual tapping operations were generally completed by daylight (6 a.m.) the collecting cups being fixed in position the day before.

From the above experiment and other experiments conducted

at Zomba it seems likely that $\frac{3}{8}$ oz. of dry rubber per tree will be a good average yield for trees over four years old in Nyasaland, and calculations should not be based on a higher return. It must be remembered that for six months in the year there is no rain, and tapping is therefore only practicable during dry spells in the rainy season and for one or two months after the rains have ceased. Tapping cannot be continued during the hot dry months as the latex flows too slowly to give a paying return, and the excessive heat of summer prevents the incisions from healing. For trees up to six years old, the above system is more suitable than the vertical or herring-bone system, but for trees over six years old the vertical system is preferable as the bark becomes too thick for the successful working of the system already described. Experiments conducted at Zomba with the vertical and pricking systems showed that the cost of collection was 1*s.* and 1*s.* 3*d.* respectively per lb. of dry rubber collected. A marked difference in the flow of latex from cultivated and uncultivated Ceará rubber was also noticed, and thorough cultivation up to the fourth year is absolutely necessary to obtain good results.

It is a general practice in Nyasaland to grow cotton as a catch crop with rubber for the first two years, and several estates have found the profits from cotton pay for the first three years' cultivation. This is much preferable to having the land covered with weeds and grass; the cultivation given to the cotton more than compensates for the small amount of plant food removed from the soil.

Planters in Nyasaland are not advised to take up Ceará rubber on a large scale, as little or no information is available regarding the life of the trees or as to how they stand tapping. Experience so far shows that Ceará is successful when planted in suitable soil and cultivated, but a failure when planted in exhausted soil or left without cultivation. It has been demonstrated that the quality of the rubber is satisfactory, two experimental packets of 45 lb. having sold at 8*s.* 10*d.* per lb. in London. The export of rubber from Nyasaland in 1909, including wild rubber, amounted to 27,000 lb., being an increase of 10,000 lb., approximately, on that of the previous year.

THE POISONOUS PROPERTIES OF IMMATURE SORGHUM.

IN a previous number of this *Bulletin* (1906, 4. 333) mention was made of the well-known fact that immature green sorghum frequently exhibits marked poisonous properties, and an investigation of such sorghum at the Imperial Institute some years ago proved that this was due to the production of prussic acid, the acid being formed by the interaction in the presence of water of a glucoside, dhurrin, and a specific enzyme, both occurring in the plant. Since that time a good deal of attention has been given to this subject in tropical countries where sorghum is grown as a green feeding-stuff, and it has been shown that the amount of prussic acid obtainable varies very much with the cultural variety of sorghum, and, in fact, that some varieties yield little or even no prussic acid, and are consequently harmless even in the immature state.

A number of varieties of sorghum are grown in Northern Nigeria by natives, and Dr. Dalziel, a Government medical officer in that Protectorate, has recently supplied to the Imperial Institute a short memorandum giving information available among natives, as to the toxicity or otherwise of the sorghum and other cereal grasses grown. The three cereal grasses dealt with are sorghum or "dawa" (*Sorghum vulgare*), "millet" or "gero" (*Pennisetum spicatum*) and "maiwa" (a cultural variety of *P. spicatum*).

The following are Dr. Dalziel's conclusions on the subject :—

"In general it would appear that the poisonous property of growing cereals is little recognised in the western part of Hausaland, but that in the eastern provinces and Bornu this effect is more familiar to the natives, and that *maiwa* is much more generally known to be injurious than either *gero* or *dawa;* as regards the last-mentioned plant opinions differ widely.

"As to the stage up to which such an effect is known, the usual illustration is the height of the knee, but answers to the questions on this point are rarely straightforward.

"From casual observation, apart from native statements, one observes that horses and other animals are not restrained from eating growing shoots of *gero* or *dawa* in passing, though they

would probably not be allowed to browse on these from economic reasons as well as because of possible harm. These crops are not fenced in, and though donkeys and pack-bullocks are muzzled at this time of year when crops are growing, this is to prevent trespass, or, in travelling, to avoid delay. There is a distinct tendency, however, to prevent animals from eating *maiwa*.

"The natives with tolerable uniformity attribute most of the evil effects, if any, of eating growing cereals and some wild grasses, to the presence of insects swallowed with the leaves. Practically every independent inquiry elicits this belief, and it may therefore be of interest to append what information on the subject has come up in the course of the inquiry.

"The insect called *haki* (properly *mugun-haki*, or the 'evil thing of fodder grass') is a very slender-bodied species of mantis. Three varieties are described—a straw-coloured one, a yellowish-brown one, and a grass-green one—the last called *dainyar-chiawa*, or in Fulani *kuddol-borodo*. These occur in grass or in growing corn of all kinds, and if accidentally eaten are said to cause death, with rapid swelling of the abdomen in a few minutes. The fact that the insect is generally out of sight in the leaf-sheath may possibly explain the statement that in some cases the stem and not the leaf is hurtful. Besides indigo, *kanwa* (Bornu salt, or natron, see p. 404) is sometimes given to induce purging, and is said to be a successful treatment. Apart from the utter improbability of the insect being the true cause of the effects described, the native statement that death occurs very rapidly is a gross exaggeration, as further inquiry always shows that even in fatal cases animals may live for several days, and the condition is amenable to treatment. Natives confuse the condition with that caused by the well-known plant called *tururibi* (*Lasiosiphon Kraussii*, Meisn), which is exceedingly poisonous and rapidly fatal.

"In Eastern Hausa, *e.g.* Katagum, *maiwa* grain is always considered injurious to horses and unwholesome for man, but in Sokoto there appears to be less prejudice against this variety of millet. It is exposed for sale in Sokoto market, and the poorer people at least buy it freely, much the same as *gero*, or knowingly mixed with the latter. *Maiwa* is also the staple diet of the Fulani of the Arewa district of Gando sub-province, bordering on

French territory, and in some parts of the latter, across the Anglo-French boundary *maiwa* is the chief cereal or the only one which the soil will support. It is said that it is harmless if properly husked.

"Further inquiry as to the supposed cause of the unwholesomeness of *maiwa* grain elicits the following information:—

"'*Dawa*, *gero*, and *maiwa* are all subject to a blight or smut, *maiwa* much more frequently and more seriously. In *maiwa* this is called *domana*, or, specifically, *domanar maiwa*, and has the characters of a gummy secretion of sweet taste affecting the fruiting spike. The effect on man of eating this as food is to cause numbness and swelling, but suitable treatment and change to other food can prevent a fatal result. Washing the affected grain and discarding the more obviously diseased is said to render it harmless.

"*Domana* in *gero* is less frequent, and when it occurs is considered of less importance, but *gero* grain is often adulterated with *maiwa*.

"The equivalent to *domana* in *dawa* is called *derba* when it affects the leaves and stems, and causes illness and even death in cattle. In the head of grain this has a special name, *bunsuru* (*burtintina* in eastern Hausa), and occurs as a smut or dark snuff-like powder. As it is easily shaken off in beating the grain from the stalk and winnowing, it is not likely to be eaten in quantity, and is therefore not considered harmful."

In addition, Dr. Dalziel states that one native in Sokoto informed him that the young secondary shoots of Guinea corn springing up before the succeeding rains form the bases of the stems left after harvest, are very poisonous and fatal to cattle. These secondary shoots are known as *geamro* (Hausa) or *bafurih* (Fulani). Similar effects are said to be produced with "gabarra" (probably *Sorghum halepense*). A native of Bornu stated that *dawa* may be poisonous as long as it is less than the height of the knee, but only in dry localities or in seasons of drought, when the plants become wilted. The same native stated, however, that *maiwa* is always poisonous to goats and even to cattle, but this he ascribed to insects on the stem.

The causes to which the occasional toxicity of these grasses are ascribed by Dr. Dalziel's native informants are curiously

similar to those put forward in India to explain the occasionally poisonous character of sorghum in that country, viz. abnormality of growth due to drought or the attacks of insects (see *Watt's Dictionary of the Economic Products of India*, Vol. VI. Part III. B. p. 303).

The first investigations carried out at the Imperial Institute on this subject were made on Egyptian young green sorghum and furnished, as already indicated, conclusive evidence that the toxicity of this material in the young stages was due to the formation of prussic acid. Later on Indian-grown young green sorghum was also examined and found to yield prussic acid, and similar observations have since been made by independent investigators in the United States, West Indies, Australia and elsewhere, and there can be no doubt now that when sorghum is poisonous in the early stages of its growth this is due to the production of prussic acid in the manner already indicated. The investigations of Treub in Java have shown that in plants such as *Pangium edule* and *Phaseolus lunatus*, which under certain circumstances yield considerable amounts of prussic acid, there is good reason to believe that the acid or the substance which generates it in the plant serves as a primary product for the building up of more complex substances. It is therefore reasonable to suppose that when plants which produce prussic acid, or a substance capable of yielding this acid, as a part of their normal physiological processes, are subjected to adverse conditions such as drought or insect attack they may form prussic acid, or a substance capable of generating it, in abnormal quantity, and under such circumstances may easily become toxic. This subject is discussed in some detail in a paper "On the Chemical Aspects of Cyanogenesis" contributed by Prof. Dunstan and Dr. Henry to the York meeting of the British Association in 1906, and Dr. Dalziel's observations in Northern Nigeria add a further confirmation of the various facts recorded there, in favour of the view that abnormal conditions such as drought may lead to the production of relatively large quantities of prussic acid or its derivatives in certain plants. A sample of Guinea corn and one of millet (*Pennisetum typhoideum*) from Northern Nigeria have been submitted to the Imperial Institute recently for examination, but both of these

consisted of nearly mature plants, and consequently it was scarcely to be expected that they would yield prussic acid, since it is now well established that in sorghum at least, the glucoside dhurrin, which is the source of the prussic acid, is only present in the early stages of growth, and disappears entirely as the plant approaches maturity. In this instance the Nigerian millet yielded a mere trace of prussic acid, but none could be obtained from the sorghum. There can be very little doubt, however, that the poisonous immature sorghum of Northern Nigeria owes its toxicity to the production of prussic acid, but in order that this may be definitely ascertained a supply of the young plant is being obtained from the Protectorate for examination at the Imperial Institute.

PRODUCTION AND USE OF COCA LEAVES.

COCA leaves are derived from a plant, *Erythroxylon Coca*, which occurs native in the countries along the Western Coast of South America, and especially in Peru and Bolivia. In recent years coca plantations have been formed in Java and Ceylon, and considerable supplies are now derived from these latter countries, but especially from Java. The drug is the source of the alkaloid cocaine, which is very largely employed in medicine as a local anæsthetic.

Attention has been particularly directed in recent years to the trade in coca leaves and in the alkaloid cocaine prepared from them, owing to the fact that this alkaloid has been used by natives, especially in Far Eastern countries, as an intoxicant, with the result that restrictive legislation has had to be introduced in India, the Straits Settlements, and elsewhere to prevent the spread of this "cocaine habit."

From a commercial point of view special interest attaches to the drug from the fact that an understanding is stated to have existed until recently among the comparatively few manufacturers of cocaine, whereby the prices paid by them for their raw material—coca leaves—have been kept at a low level, whilst prices for the pure alkaloid have been raised. Owing to the diminution in output

from Peru, Java has acquired a predominant position in the production of coca leaves, and a proposal has been made there recently that planters in Java should take advantage of this state of things to establish a practical monopoly in this industry. As the cultivation of coca leaves is already well established in Ceylon, and may be taken up in other British colonies, it becomes of interest to summarise the position of this industry at the present time.

The commercial supply of coca leaves is almost entirely derived from Peru, Java, and Ceylon. Coca is produced in Bolivia, Brazil and other parts of South America, but only very small quantities are exported from these countries. Experimental cultivation of the leaves has been undertaken in India, the United States, the Federated Malay States and elsewhere, but at present there appears to be no production on a commercial scale in these countries.

From Peru, both coca leaves and cocaine are exported. The cocaine produced is crude and impure, and is mostly exported to Germany, where it is refined. From Java, coca leaves only are exported at present, though it has been proposed to open a factory there for the manufacture of cocaine. The coca leaves exported from Java are stated to contain little or no cocaine, but they are rich in other alkaloids from which cocaine can be made by a comparatively simple process. All the Java coca leaves are at present said to be worked up in Holland and Germany for the manufacture of cocaine.

The statistics of export of coca leaves and cocaine from Peru, and of coca leaves from Java and Ceylon, so far as they are obtainable, are given below:—

Exports of Crude Cocaine from Peru.

Year.	To Germany.		To United Kingdom.		To United States.		To France.		Total.	
	Quantity. Kilos.	Value. £	Quantity. Kilos.	Value. £	Quantity. Kilos.	Value. £	Quantity. Kilos.	Value. £	Quantity. Kilos.	Value. £
1903	6,770	84,626	553	6,912	58	725	414	5,180	7,800	97,506
1904	6,156	76,961	959	11,987	284	3,550	128	1,600	7,527	94,099
1905	6,313	108,600	330	5,684	134	2,304	—	—	6,778	116,590
1906	5,184	69,862	424	5,532	—	—	395	3,676	5,914	79,071

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For the above figures the Imperial Institute is indebted to the Consul-General for Peru in London. According to information supplied by the Secretary to the British Legation at Lima, the total exports of cocaine from Peru amounted to 6,057 kilograms, valued at £66,630 in 1907. According to the *Boletin de Ministerio de Fomento*, published at Lima, the exports of coca leaves from Peru in 1905 amounted to 1,315,825 kilos, valued at £94,956, and in 1906 to 2,842,916 kilos, worth £130,325, but these figures are believed to be merely approximations. Later data are not obtainable.

The Consul-General for Bolivia, in London, states that the total production of coca leaves per annum, in that country, is about 95,000 cwt., but of this only a very small amount is exported.

Exports of Coca Leaves from Java.

1904	1905	1906	1907	1908
lb.	lb.	lb.	lb.	lb.
57,032	151,057	274,259	533,765	1,026,022

The above figures were compiled for the Imperial Institute, from Batavia market reports, by His Majesty's Consul at Batavia. According to the Consul-General for Holland, in London, the total exports from Java and Madura in 1908 were 416,612 kilograms, valued at 166,645 florins, and of this quantity 311,292 kilos went to Holland, 102,320 kilos to Germany and 3,000 kilos to the United Kingdom.

No cocaine is at present produced in Java.

*Exports of Coca Leaves from Ceylon.**

Year.	To United Kingdom.		To Germany.		To Belgium.		To Holland.		To Switzerland.		Total.	
	Quantity. lb.	Value. £†	Quantity. lb.	Value. £†	Quantity. lb.	Value. £†	Quantity. lb.	Value. £†	Quantity. lb.	Value. £†	Quantity. lb.	Value. £†
1906	3[illegible],301	1,534	1,182	57	1,136	38	—	—	—	—	41,724	1,669
1907	28,[illegible]42	757	1,438	19	—	—	4,239	148	11,736	389	46,986	1,348
1908	33,833	896	2,668	36	—	—	3,146	36	40,281	1,343	80,088	2,315
1909	30,20[illegible]	820	1,649	242	22,585	422	—	—	13,809	455	68,306	1,940

* *From a return supplied by the Principal Collector of Customs, Colombo.*
† *The original figures are in rupees; these have been converted at the rate R.15 = £1.*

The Trade Returns of the United Kingdom do not show imports of coca leaves or cocaine under these headings, but the

following figures of imports to the United States and to Hamburg afford some indication of the course of trade in these products.

Imports of Coca Leaves to United States.

	Quantity. *lb.*	Value. *Dollars.*
1904–5	—	342,518
1905–6	2,650,141	488,545
1906–7	1,515,616	212,424
1907–8	633,121	76,109

Imports of Medicated Leaves to Hamburg from Peru.*

	Kilos.
1905	618,600
1906	587,400
1907	354,800

If the export of coca leaves from Peru may be taken as about 1,000 metric tons per annum, and the exports of cocaine from the same country as about 6,000 kilos, then taking the Java output of coca leaves at the figure for 1908, viz. about 1,000,000 lb., the maximum possible production of cocaine per annum would be from 18,000 to 20,000 kilograms (39,000 to 44,000 lb.); but this is little more than a guess at the actual production, since a large proportion of the coca leaves which appear in commerce is no doubt used in the preparation of such products as "coca wine," "liquid extract of coca leaves," etc., and is not employed for the production of cocaine. In this connection it is of interest to note that de Jong, in a recent number of *Teysmannia* (1910, p. 201), estimates the world's consumption of cocaine at 12,000 kilograms per annum, and points out that since the yield of dry coca leaf in Java is about 286 kilograms per acre, and as this is equivalent to 6 kilograms of pure cocaine, the area under coca can be extended to about 3,500 acres in Java before the present world's consumption of cocaine is reached, assuming that export of coca leaves from Peru can be suppressed as the result of the competition of the Java product. He recommends as the most economical plan the cultivation of coca as a catch crop in Para

* Probably mainly coca leaves; the figure given for 1906 is quoted in the Hamburg Trade Returns as for coca leaves.

rubber plantations, so that a return may be secured in the first six years before the Para rubber trees are old enough to be tapped. In order that the Java planters may further secure their position he recommends that they should combine to erect a co-operative central factory for the extraction of cocaine, so that they may be independent of cocaine manufacturers in Europe. Manufacturers of cocaine in Germany, who have been consulted on the feasibility of this project, state that there would probably be a saving of from 10 to 20 shillings per 100 kilograms of leaves worked as the result of extraction in Java instead of in Europe, and they express their willingness to take a share in the erection and working of the proposed Java factory.

At first sight this suggested extension of the Java industry in coca leaves seems to offer a prospect of serious competition with the Ceylon production of this drug, but it must be remembered, in this connection, that the variety of coca leaf cultivated in Java is only suitable for the manufacture of cocaine, since it is stated not to actually contain this alkaloid, but only alkaloids nearly related to it, and which after extraction are readily convertible by chemical means into cocaine. The coca grown in Ceylon, on the contrary, appears to be of the Bolivian variety, and should therefore be available, not only for the manufacture of cocaine, but also for the production of galenical preparations of coca, the form in which the drug is usually prescribed for internal use. For this purpose carefully prepared coca leaves of high quality are required, and consequently the Ceylon coca leaves, which answer these requirements and usually fetch the highest prices obtainable for this product, should be able to retain their present commanding position so far as this particular outlet is concerned. A complete investigation of Ceylon coca leaves is now in progress at the Imperial Institute with a view to determining definitely the nature of the alkaloids present, and especially the proportion of cocaine.

THE DISTRIBUTION AND UTILISATION OF CHROMIUM ORES—PART II.

IN Part I of this article (see this *Bulletin*, 1916, p. 278), information was given with regard to the chromium ores of commercial importance and their distribution in Europe, Asia and America. In the present portion data are published as to the occurrences of such ores in Africa and Australasia, and the article concludes with a summary of information on the composition and uses of chromium ores and on their preparation for the market.

AFRICA.

Transvaal.—Serpentinised pyroxenes containing chromite have been located on the De Kroon farm, about 20 miles west of Pretoria. The ore, which carries about 35 per cent. of chromium sesquioxide and traces of platinum and gold, is somewhat difficult to concentrate, and its production in quantity is therefore rather unlikely.

In the Eastern portion of the Transvaal, chromite occurs in the Lydenburg district in a more or less continuous chain of outcrops in the basic portion of the Bushveld plutonic rocks. The ore has been found in ten different localities, and occurs in fairly well defined, bedded layers up to 5 feet thick with a dip and strike of 8 to 15 degrees in a south-westerly direction. The belt of country rock in which these deposits are embedded is about 1½ miles wide.

Chromite deposits occur in the Rustenberg district (over a length of about 28 miles) from Rustenberg to the Crocodile River. The ore has been found in twelve localities; one typical deposit forms on the surface a well-defined bar, about 10 yards wide, composed of lustrous, dark, rather compact chromite showing a slight tendency to banding on the weathered surface.

The Transvaal chromite usually consists of a hard, black, lustrous aggregate of granular ore, which weathers easily. The bulk of the ore, so far located, is of too low grade, containing only 35 per cent. of chromium sesquioxide, to permit of its being marketed without previous mechanical concentration. It is interesting to note that varying amounts of platinum, from

1 dwt. per ton downwards, have been found in chromite from Kroondaal near Rustenberg. Samples from the Secoecoeniland deposits contained from 40 to 45 per cent. of chromium sesquioxide, and up to 1·5 dwts. of platinum per ton. Samples of ore from Jachtlust, sent to the Imperial Institute, were found to contain 47·0 and 38·4 per cent. of chromium sesquioxide (see this *Bulletin*, 1909, 7. 277).

Natal.—Chromite has been found in serpentine on a farm at Tugela Rand near Krantz Kop. Specimens analysed were found to contain from 25 to 28 per cent. of chromium sesquioxide, but no information is available as to whether these samples were representative of the material obtainable, or as to the extent of the deposit.

Southern Rhodesia.—During recent years Rhodesia has steadily increased its production of chrome ore, the total quantity produced up to January 1910 being 55,485 tons, valued at £139,099. The ore is largely shipped *via* Beira. A report on a sample of chromite from Rhodesia examined in the Scientific and Technical Department of the Imperial Institute has been published in this *Bulletin* (1907, 5. 136).

AUSTRALASIA.

Victoria.—Chromite does not appear to have been produced commercially in this State, but the mineral has been found in the serpentine area of Wellington River, Gippsland. The deposit occurs about a quarter of a mile east of the junction of Thiele's Creek with Dolodrook Creek, the southern branch of the Wellington River, and although little development work has been done, masses of several hundredweights have been uncovered. Pieces of the ore have been found over an area of 50 acres, but it is unlikely that the deposit can be profitably worked, at present, owing to lack of transport facilities.

New South Wales.—The deposits of chromite in this State first began to receive attention in 1882, and as the result of active prospecting in 1893 the ore was found in over sixty localities. The largest production recorded for any one year was in 1899, when 5,242 tons were produced. Since that time the production has declined, owing, it is stated, to the quality of the ore not being quite up to market requirements, averaging 45 to 47 per cent. chromium sesquioxide. The ore was first

produced from the Bowling Alley Point deposits situated near Nundle, Peel River, where it occurs in quantity in an outcrop about 700 feet above the Point. Analyses of samples, made in 1892, showed from 37 to 47 per cent. of chromium sesquioxide. The deposits at Gordonbrook, Clarence River, were worked in 1891 and 1895, and about 30 tons of ore exported. They occur at Pucka, about 30 miles north-west of Grafton. Much of the ore is mixed with serpentine, and would require dressing before being exported. It occurs chiefly along the junction of the serpentine and the rock into which the latter has intruded. Bunches of ore measuring 12 feet by 12 feet and 24 feet by 18 feet have been located. Neither of the attempts to work these deposits has proved successful, probably because the ore had to be hauled 24 miles by team to the nearest navigable point on the Clarence River.

During recent years the bulk of the chromite produced in New South Wales has been obtained from the Gundagai district. The deposits occur at Mount Lightning, about 4 miles north-east of the Coolac railway station, and were first opened in 1892, producing about 2,000 tons of ore in 1895. The ore from some of the deposits is stated to contain from 49 to 56 per cent. of chromium sesquioxide, but no work was done during 1909, owing, it is said, to there being no market for the average quality of ore available.

Western Australia.—No chromite is produced in this State, but a chromiferous iron ore occurs at Comet Vale, North Coolgardie. The ore has the following percentage composition:—Ferric oxide, 79·01; chromium sesquioxide, 5·30; silica, 3·14; phosphorus 0·078; sulphur, 0·124.

Queensland.—Chromite has been found in the belt of country from Keppel Bay to Marlborough in numerous patches spread over large areas, but the quantity of ore shown does not in any case exceed 100 tons. It is stated to occur in boulders on the surface at Pine Mount, Ipswich, but the quantity available is not known. Deposits of considerable size are reported to occur to the north of Rockhampton in the Cawarral district, and material from the Elgalla Mine at Tooker's Hill has been used for the manufacture of firebricks.

Tasmania.—Chromite does not appear to have been produced to any extent in Tasmania, but it is known to occur in the

Pieman alluvial of the North Dundas tinfield and in all the creeks which flow away from the basic rocks of the locality.' There are large deposits available of a brown hæmatite, which contains about 3 per cent. of chromium sesquioxide and very little sulphur or phosphorus. This ore occurs in the Ironstone Hill, near the River Tamar, at Port Lampiere, and it is estimated that there is over half a million tons of ore in sight on the surface, in the form of boulders of various sizes. The ore was smelted by a Tasmanian Company in 1872, and several hundred tons of iron containing 6·7 per cent. of chromium was shipped to the United Kingdom.

New Zealand.—No chromite appears to have been produced in New Zealand since 1902, when about 175 tons came from Onatea, Croixelles harbour, where the ore occurs in elliptical masses, 1,200 feet above sea level, and no export was recorded from 1866 until 1901, when 28 tons were produced. The Onatea deposits have been proved only to a limited depth. The more important chromite deposits of New Zealand occur associated with the magnesian rocks of the Dun Mountain mineral belt of the Nelson district. The Dun Mountain rises to a height of about 4,000 feet above sea level and occupies an area of about 4 square miles. The mountain is composed largely of massive olivine in which chromite occurs uniformly disseminated as fine grains and occasionally in large masses. The deposits of chromite of workable size are found in the serpentine belt, which is half a mile wide and occurs between the olivine and the limestone which forms the base of the sedimentary formation. In the Nelson district, the ore has been traced from D'Urville Island to the gorge of the Wairoa River. The chief developments of the ore are found between the upper Matai valley and the Lea River, a distance of 12 miles.

The bulk of the ore exported has been obtained from one outcrop near Dun Mountain, a small quantity also being procured from Little Ben Nevis. Chromite has been found in the Lake Harris range at Milford Sound, also at Moke Creek, Otago.

New Caledonia.—A large proportion of the world's production of chromite comes from New Caledonia, where the mineral was first discovered in 1874. The chief deposits at present located are in the southern portion of the island. The ore is found in two forms, viz. as rich, soft and easily broken masses in ferru-

ginous clay, and as veins and included masses in the hard serpentine rock. The more friable ore is that most sought after, as it is easier to separate from the associated rock.

The largest deposits are in the north around the Tiebaghi mine, which yields per month about 4,000 tons of ore carrying up to 67 per cent. of chromium sesquioxide. The only chrome ore mine in the island, worked below the surface, is the Lucky Hit in the group of mines to the south of Noumea. This ore, as mined, contains from 30 to 40 per cent. of chromium sesquioxide, and is concentrated mechanically to raise it to marketable quality. The freight from New Caledonia to Europe averages 28*s.* per ton for chromite. The price obtainable for ore, carrying 50 per cent. of chromium sesquioxide, f.o.b. Noumea, in 1909, averaged £1 14*s.* 6*d.* per ton, and £1 2*s.* per ton at the mines.

Composition of Chromium Ores.

The following are results of analyses of typical chrome ores from some of the localities mentioned :—

	Chromium sesquioxide Cr_2O_3	Ferrous Oxide FeO	Alumina Al_2O_3	Silica SiO_2	Magnesia MgO	Lime CaO
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
United Kingdom—						
Shetland Islands	44·20	24·93	7·47	6·10	17·30	—
Hungary—Orsova	38·95	16·13	17·50	8·00	17·20	2·20
Norway—Drontheim	42·00	19·72	12·00	5·00	21·38	—
Russia—Urals	55·75	21·56	3·37	5·37	13·85	0·60
Ekaterinburg	49·49	23·27	6·77	7·07	13·40	—
Orenburg	53·00	24·92	8·05	3·05	10·98	—
Asia Minor—Broussa	56·80	12·06	14·00	1·45	15·00	0·70
Broussa*	60·14	15·70	6·34	1·08	16·40	
Ceylon—Bambarabotuwa Dist.,*						
Central Provinces	46·58	19·90†	2·86	trace	5·63	—
British North Borneo—						
Malliwalli Island *	51·21	18·90	9·58	1·04	16·46	—
United States—						
Shasta Co., California ...	42·45	15·00	16·75	7·50	16·50	0·90
San Luis, Obispo Co., California (crude ore)... ...	43·70	14·00	15·96	7·96	16·49	0·66
(concentrate)	52·86	15·45	11·59	3·00	16·26	0·76
North Carolina, Corundum Hill	57·20	25·68	7·82	2·80	5·22	—
Pennsylvania, Chester ...	41·55	62·02‡	—	1·25	—	—
Canada—Coleraine (crude ore)	45·9[illegible]	22·50	8·90	7·68	4·90	0·12
Black Lake (concentrate) ...	50·35	17·77	9·90	3·10	16·02	1·80
Bolton	45·90	35·68	3·20	—	15·03	—
Newfoundland—						
Port-au-Port Bay	49·23	17·21	7·50	6·51	18·66	—
Africa—Transvaal	37·03	23·95	17·23	7·63	9·94	2·00
Rhodesia*	46·36	18·[illegible]6	13·18	4·58	13·64	—
*New Caledonia**—(cargo sample)	54·50	17·70	11·00	3·10	8·00	1·50

* *Analyses made in the Scientific and Technical Department of the Imperial Institute.*
† *Also contained* 25·05 *per cent. of Ferric oxide.*
‡ *Total iron calculated as Ferric oxide.*

PREPARATION OF CHROMITE.

As already indicated, the crude mineral generally requires dressing to bring it up to market requirements. For this purpose it is subjected to either "hand cobbing" or mechanical dressing. The "hand cobbing" consists in breaking down the ore to such a size that it can be hand picked. If the breaking is done by means of a jaw crusher, a large quantity of "fines" may be produced, which will need further treatment. The ore after breaking is passed over a screen, to separate the lumps of ore from the "fines," and is then hand sorted from a slowly revolving table. The ore is usually dressed to give a product containing about 50 per cent. of chromium sesquioxide.

If mechanical dressing is resorted to, the ore is first sent to a "Blake Crusher" and then to a tamp battery, where it is ground to pass a 20-mesh screen. The "pulp" from the stamps passes direct to a Wilfley table, where it is divided into three grades: "heads," "middlings," and "waste"; the "middlings" being passed to another table producing "heads" and "waste." As a general rule, for each 20 stamps there are four tables and one additional table for treating "middlings."

The power necessary for the mechanical dressing of chromite varies necessarily with the ore treated, but 61 horse-power may be taken as that needed for a 20-stamp mill, and the necessary crushing, concentrating and conveying plant. A mill of this capacity will treat about 40 tons of ore per day. The consumption of water for such a mill is approximately 3,000 gallons per hour.

The customary grading and also the effects of concentration may be illustrated by the following analyses of ore from Coleraine, Canada:—

	Chromium sesqui-oxide.	Ferrous oxide.	Alumina.	Silica.	Magnesia.	Lime.
No. 1 Crude ore	51·06	13·63	14·66	4·18	14·20	2·27
No. 2 " "	45·26	12·72	16·80	4·61	18·27	2·34
No. 3 " "	40·12	11·20	18·63	4·87	22·52	2·65
Concentrates	53·64	11·47	14·02	2·31	15·75	2·81
Tailings	2·86	traces	32·55	16·15	45·26	4·18
Slimes	1·27	traces	31·33	17·03	46·16	4·24

In Canada it is not usual to work a deposit where the ratio of rock mined to that sent to the mill is greater than 4 to 1, and on the average the chromite constitutes from 40 to 60 per cent. of the low grade milling rock.

VALUATION OF CHROMIUM ORES.

During the last fifteen years the price of chromite has fallen steadily. First grade ore (hand sorted and cobbed) containing 50 per cent. of chromium sesquioxide is worth about 45*s.* per ton, c.i.f. United Kingdom ports, with an addition of 1*s.* 6*d.* per unit for each unit per cent. above 50 (June 1909).

UTILISATION OF CHROMIUM.

A use for the crude ore which has acquired importance in recent years is as a furnace lining, ores containing as high as 8 per cent. of silica being readily saleable for this purpose. The chromite is made into the form of bricks by admixture with tar, lime, bauxite or kaolin. These bricks, it is claimed, have a much longer life than the ordinary acid or silica bricks, since owing to their neutral character they resist corrosion and therefore are of value in furnaces used for smelting lead, copper and antimony, the slag from which rapidly attacks acid linings. The crude ore is also employed for lining certain parts of the furnaces employed in the production of basic open hearth steel. Chromite, as a furnace lining, has the disadvantage of being about twice as costly as magnesite bricks.

The chief use of chromium ores at present is for the production of chromates and chrome pigments. For the manufacture of chromium compounds, concentrates containing not less than 48 per cent. of chromium sesquioxide are usually employed. Potassium dichromate is employed for the production of chrome-yellow (neutral lead chromate) and chrome orange, which are both used in calico printing, for the bleaching of palm oil, the discharge of indigo blue, and in the preparation of certain green ceramic pigments. Chromium sesquioxide is a valuable indelible green pigment. Chromium salts, such as the sulphate and chrome-alum, are largely employed in the various chrome processes for tanning leather.

Chromium Alloys.

The alloys of chromium with iron have recently acquired great technical importance in connection with the production of hard steels. Ferro-chromium is a tin-white, hard, brittle alloy with a crystalline structure, and is now produced on a commercial scale in the electric furnace. The energy consumed amounts to about 10·6 HP. hours per kilogram of alloy obtained. The electric furnace method has the advantage of producing an alloy containing a higher percentage of chromium and a lower percentage of carbon than can be produced by the blast or crucible furnace methods formerly in use. The composition of some ferro-chromium alloys of commerce is shown in the following table:—

Chromium	67·000	71·980	69·600	63·586
Iron	24·380	22·610	28·452	35·596
Carbon	8·050	4·789	1·560	0·650
Silicon	0·490	0·550	0·350	0·140
Sulphur	0·007	0·061	0·038	0·028
Phosphorus	0·005	0·008	trace	trace

The chromium steels made by the addition of ferro-chromium to steel may be classified into (1) ternary steels (containing only iron, carbon and chromium), (2) quaternary steels (containing iron, carbon, chromium, and one other element such as nickel, manganese, tungsten, or molybdenum). Chrome steel is extremely hard, tough and dense, and possesses great tensile strength. It is, therefore, specially suitable for machinery parts subject to hard wear, such as crusher jaws, stamp shoes, etc. It can be welded to iron and rolled out, and is, therefore, said to be of special value for the construction of safes, as the coating of iron protects the chrome steel from fracture by blows and the steel is hard enough to resist ordinary drills. Steel containing about 2 per cent. of chromium and a small amount of nickel finds extensive application.

Production of Chrome Ores.

Statistics for the production of chrome ores are very incom-

plete, but the following table gives the figures so far as they are available:—

	1906.		1907.		1908.		1909.	
	Metric tons.	value £	Metric tons.	value £	Metric tons.	value £	Metric tons.	value £
Bosnia . . .	320	799	310	1,031	500	1,457	—	—
Greece . . .	11,530	17,295	11,730	19,706	4,350	6,992	—	—
Russia . . .	16,976	10,994	26,357	17,125	—	—	—	—
Asia Minor (Turkey).	—	—	28,860	90,470	—	—	—	—
India . . .	4,445	7,188	18,597	24,404	4,821	6,338	9,398	—
Japan . . .	—	—	2,290	—	2,204	—	—	—
United States . .	109	370	295	1,158	365	1,485	—	—
Canada . . .	8,196	18,875	6,528	14,980	6,555	16,851	—	—
S. Rhodesia . .	3,308	10,375	7,273	20,468	12,118	37,024	26,140	—
New South Wales .	15	15	30	105	nil	nil	·	—
New Caledonia .	84,241	156,680	3,800	22,440	15,800	23,640	32,086	—

APPENDIX.—Since the publication of Part I. of this article in this *Bulletin* (1910, 8. 278) information has been received at the Imperial Institute of the occurrence of chromite in the Bombay Presidency, India, at a locality some 60 miles south of Ratnagiri. It is stated to occur in vast ore-bodies associated with serpentine. Extensive outcrops have been found at two places within a distance of about three miles of each other. In one the outcrop is stated to be sixty yards wide, and to extend over a distance of about one-fifth of a mile. In the other the outcrop is about a hundred yards wide and a quarter of a mile long. Large boulders of chrome ore, some of which reach several tons in weight, are stated to be lying on the surface. One of these localities is traversed by a river of considerable size, which cuts through the belt of chromite and affords an ample and constant supply of water. It is further stated that there is a good road with easy gradients to the coast, which is about 25 miles distant from the deposit.

With the information given above, was supplied an analysis of the crushed and panned ore which showed this to contain 50·49 per cent. of chromium sesquioxide and 23·94 per cent. of ferrous oxide.

A specimen of the ore has been received at the Imperial Institute. It consisted of a granular and fairly friable ore which could be easily crushed with the production of little or no powder. The crude material was found to contain 33·98 per

cent. of chromium sesquioxide and the concentrate obtained by crushing and electro-magnetic separation contained 52·66 per cent. of chromium sesquioxide. From a comparison of the analyses of the two concentrates it seems clear that the most economical method to adopt in dressing the ore would be that of hydraulic concentration. The area appears to be a promising one as a source of chromite.

GENERAL NOTES.

Appointment.—Mr. G. C. Dudgeon, Inspector of Agriculture for British West Africa, who has been *ex officio* attached to the Imperial Institute, has been appointed Director-General of Agriculture in Egypt.

Ceylon Mineral Survey.—The report by the Director of the Imperial Institute on the results of this Survey in 1906–07 and 1907–08 has now been issued as No. 74 of the Miscellaneous Series of Colonial Reports [Cd. 5390]. The work in Ceylon is carried on by surveyors, who submit periodical reports recording the results of their field work in the island, and collect specimens of minerals likely to be of economic interest, for examination at the Imperial Institute. The present report contains summaries of the geological work accomplished during the period 1906–08, and gives the results of the mineralogical and chemical examination at the Imperial Institute of the minerals collected. The continuation of the Survey is now in progress, Mr. J. S. Coates and Mr. F. D. Paisley being the Surveyors in Ceylon.

Report on the Present Position of Cotton Cultivation.—This report, presented by Prof. Dunstan to the International Congress of Tropical Agriculture held at Brussels in May 1910, has been published by the International Association of Tropical Agriculture and Colonial Development. It summarises the various problems which confront those interested in the extension of cotton cultivation at the present time, and indicates the directions in which solutions of these problems should be sought. Appended to the report is a series of summaries of special reports submitted by experts in almost every country in which cotton cultivation is now an industry of importance or in which experiments with the growth of this crop are being carried on. The report is published at 1*s.* (post free 1*s.* 1½*d.*), and copies can be obtained on written or personal application to the Central Stand in the Exhibition Galleries of the Imperial Institute.

Native Leather of West Africa.—In a previous article on this subject published in this *Bulletin* (1908, 6. 175) statistics were given [illegible] trade in West African leather, and a detailed description was

printed of the method of preparing the leather, with notes on the materials used, and it was then pointed out that further details were needed respecting certain parts of the process of preparation. The Imperial Institute has received recently from Dr. D. Alexander, a Government medical officer in Northern Nigeria, a series of notes on the preparation of leather as practised (1) by the Kanuri natives of Bornu Province and (2) by Hausas, and from this source it is possible to supplement the information already published (*loc. cit.*).

The raw material consists, as already explained, of the skins of goats and sheep, and this is unhaired or depilated, both by the Kanuri and the Hausas, by the use of a strongly alkaline preparation known as "toka," which consists of the ash obtained by burning the wood of the "Merki" (probably *Anogeissus leiocarpa*, see p. 355) or the "Anum" tree, or by burning the vegetable and other refuse from tanning and dyeing pits with wood from Merki, Anum, or Karumga (*Acacia Seyal*, see p. 357) trees. A sample of "toka" was supplied to the Imperial Institute recently by Dr. Foy, of the Northern Nigeria Medical Service. On analysis this proved to have the following composition:—

		Per cent.
Lime	CaO	18·45
Magnesia	MgO	2·03
Ferric oxide and alumina	Fe_2O_3 and Al_2O_3	7·79
Silica	SiO_2	65·96
Sulphuric anhydride	SO_3	0·22
Phosphoric anhydride	P_2O_5	0·86
Carbon dioxide	CO_2	2·09
Water	H_2O	2·12

No organic matter was present, and the silica occurred almost entirely as sand. "Toka" is therefore very largely quicklime mixed with sand and other impurities, and its use as a depilatory corresponds with the similar use of lime in European tanyards.

In the previous article it was pointed out that the information then available seemed to indicate that no separate bating process was used in Nigeria, but it appears from Dr. Alexander's notes that the Kanuri natives use for this purpose the excrement of the "kairo" bird (*Pyromelana afra*), or if this is not obtainable, the excrement of domestic fowls is employed, or in the absence of both of these the husk of guinea corn heads, known as "dousa," is utilised. The Hausas, however, always use "dousa" as a bate. These three substances employed as bates correspond fairly closely with the pigeon dung used in European tanyards, and with the bran bate employed from time immemorial in Egypt and India. The tanning and dyeing processes employed by the Kanuri and the Hausas do not differ materially from those described in the previous article, the tanning material employed being always the pods of *Acacia arabica* (known as "gabarrua" or "baggarua"). The red and yellow dyes used are "red sorghum" and turmeric root respectively,

but it is noted that red leather only is produced regularly, the yellow and green sorts being invariably made to order or for special requirements. Further, the skins to be dyed red are oiled with ground-nut oil before the application of the dye, but skins to be dyed yellow or green are not oiled. The only green dye employed by Kanuri natives is an imported "aniline" dye, and Dr. Alexander notes that the natives are unfortunately also beginning to use imported magenta crystals as a substitute for red sorghum; and in Adamawa, but not in Bornu or Kano, an imported artificial yellow dye is also invariably used for dyeing leather yellow. The alkali used by the Kanuri in preparing the dye baths with either red sorghum or turmeric is a local "potash" known as "kanwa," but the Hausas employ "toka" (see above) for the preparation of the red dye bath. "Kanwa" is a mixture of sodium bicarbonate and sodium carbonate, and closely resembles the mineral "trona," in composition (see Second Report on the Results of the Mineral Survey in Northern Nigeria [Cd. 3914], pp. 8 and 9).

Tobacco from the Transvaal.—This tobacco was forwarded to the Imperial Institute by the Tobacco Expert of the Department of Agriculture for the Transvaal in February 1910.

It consisted of three bundles of "bright" tobacco leaves in good condition. The colour was good and fairly even, though it showed a tendency to brown in some of the leaves. The average size of the leaves was 16 by 7½ inches.

The tobacco burnt excellently, leaving a pale-grey ash. The aroma and flavour of the smoke were moderately good.

On analysis the tobacco gave the following results:—

	Per cent.
Moisture	6·9
Nicotine	1·2
Total nitrogen	1·6
Ash	7·5

The following were the chief constituents of the ash:—

		Per cent.
Potash	K_2O	27·87
Soda	Na_2O	0·27
Lime	CaO	21·98
Magnesia	MgO	10·69
Sulphuric anhydride	SO_3	2·35
Chlorine	Cl	0·17

The tobacco is of satisfactory composition and burning quality, and was described by tobacco experts, to whom it was submitted, as a very successful attempt at producing a "bright" Virginia tobacco. They valued it at 4*d.* or 5*d.* per lb., or rather more for larger leaves.

Pigeon Peas from Sierra Leone.—A small consignment of "Pigeon peas" was received from Sierra Leone in February of this year. It consisted of small, slightly-flattened peas of light fawn colour, with well-marked hilum showing a brown spot at either end. The consignment was clean and in good condition.

On analysis the peas gave the following results:—

	Per cent.		Per cent.
Moisture	9·1	Fibre	6·4
Crude proteins	18·1	Ash	3·6
Fat	1·0	Nutrient ratio	1 : 3·5
Starch, etc.	61·8	Food units	109·5

The peas when ground and moistened with water yielded no prussic acid.

A sample of these peas was submitted to commercial experts, who valued them for feeding purposes at £4 to £5 per ton in London (June 1910).

Land for Rubber Cultivation in British Guiana.—In a previous number of this Bulletin (1908, 6, 214) particulars were given of the conditions on which Crown Lands in British Guiana were leased for rubber cultivation. These conditions have recently been revised in the Crown Lands Regulations, 1910, and copies of *The Official Gazette* of British Guiana containing the terms now in force may be seen at the Imperial Institute.

The main conditions remain unaltered, viz.: those regarding (1) the length of lease, (2) the rent or purchase price, (3) the royalty on the rubber or balata obtained during the first ten years, and (4) the obligation of the lessee to plant a certain area of the land leased with rubber trees.

The fees payable for obtaining a lease are as follows:—

	$	c.
Application	5	00
Survey—Area up to 500 acres, per acre		30
Each acre above 500 and up to 1,000		20
Each acre above 1,000		10
These charges include labour, cutting lines, etc.		
Cost of preparing lease, say	16	20

All applications for land must be addressed to the Commissioner of Lands and Mines at Georgetown, British Guiana.

Pecan Nuts.—Among the forest trees of North America, there are about a dozen species of *Carya* or hickory, which are closely related to the walnut. One of these (*C. olivaeformis*), known as the pecan or

Illinois nut tree, produces an edible nut of such a flavour as to be regarded by connoisseurs in the United States as the finest of all nuts. Another species, *C. alba*, yields a valuable timber.

The pecan tree grows to a height of sixty to seventy feet, and the trunk has a diameter of two feet or more. During the last twenty years, the tree has assumed considerable importance in the United States, and extensive orchards have been planted in most of the Southern States. It requires a warmer climate than the common hickory tree (*C. alba*) and grows best in the semi-tropical zone and the warmer regions of the temperate zone. The tree is well adapted to cultivation in the Mississippi Valley below St. Louis, and in the South Atlantic and Gulf States, including Texas. It is also grown in certain parts of France, and attempts have been made to introduce it into England, but the climate has proved unsuitable.

The pecan tree flourishes on deep, rich, alluvial soil, and succeeds airly well on upland soils of moderate richness. The method of cultivation resembles that of the walnut. Most growers plant the young trees about forty feet apart, but some authorities are of opinion that better results are obtained when they are set at a distance of sixty feet from one another. Planting may be done either in the autumn or spring. One of the chief difficulties encountered in the cultivation of the pecan tree is its propagation. The tree cannot be satisfactorily propagated by means of seedlings, as these do not come true to type and frequently bear nuts but little superior to the common wild forms. Considerable attention has, therefore, been given to grafting and budding. A careful study of the latter has been made by the United States Department of Agriculture, and the results of the investigation are embodied in a report issued in 1902 as Bulletin No. 30 of the Bureau of Plant Industry. The trees are long-lived; they sometimes begin to bear fruit at an age of four or five years, but, as a rule, do not yield a profitable crop until they are ten years old.

The nuts are from one to two inches long, have a thin, woody husk, are of a light brown colour, are shaped like an olive, and are indistinctly marked with four slightly-raised longitudinal ridges. They are offered or sale in all the large towns of the United States, and form an important article of commerce. There is also a small market for these nuts in the United Kingdom. The cultivation is said to be very profitable. There are a good many cultivated varieties of the pecan tree, some of which have been described in the Year Book of the Department of Agriculture of the United States (1904, 407; 1905, 504; 1908, 485).

The wood of the pecan tree is suitable for many purposes, and is especially adapted to the requirements of the cartwright. It is, however, coarser and less elastic than hickory wood.

Attention has recently been drawn to the value of the pecan tree by Dr. A. W. Stirling, of Atalanta, Georgia, who has strongly recommended it for cultivation in certain British Colonies.

The Antiseptic Value of Cyprus Origanum Oil.—The Cyprus origanum oil so far imported to this country with the assistance of the Imperial Institute has been mainly used as a perfume for soap; but in the first report on this oil published in this *Bulletin* (1906, 4. 298) it was pointed out that the investigations carried out by Cadeac and Meunier in France had shown that Cretan origanum oil possessed strongly antiseptic properties, and that since the Cyprus oil contained far more carvacrol than the Cretan product, it seemed likely that its antiseptic power was far greater. There is a very large demand for thyme oil to be used in the preparation of thymol, employed as an antiseptic in various toilet preparations. It seemed likely that Cyprus origanum oil, the odour of which is similar to that of thyme oil, and which contains no less than 82 per cent. of carvacrol, an isomeride of thymol, could be successfully used as a substitute for thyme oil if it could be clearly established that carvacrol is as strongly antiseptic as thymol. It is therefore of very great interest to note that in a paper on "Essential Oils in relation to their Antiseptic Powers, as determined by their Carbolic Coefficients," by Dr. W. Harrison Martindale, published in the current number of the *Perfumery and Essential Oil Record*, it seems to be clearly established that of all the essential oils and their constituents examined, origanum oil had the highest carbolic acid coefficient, viz. 25·76, being followed by thymol 25·29 and carvacrol 21·32. This means that by the test employed origanum oil is 25·76 times as strong an antiseptic as pure carbolic acid. The origin of the origanum oil used by Dr. Martindale is not stated, but it was probably the Cyprus variety, since it contained 82 per cent. of phenols (carvacrol), and this exceedingly high percentage of phenols distinguishes the Cyprus oil from all other origanum oils at present on the market.

RECENT REPORTS FROM AGRICULTURAL AND TECHNICAL DEPARTMENTS IN THE COLONIES AND INDIA.

In this Section of the Bulletin a Summary is given of the chief contents of general interest of Reports and other publications received at the Imperial Institute, from Agricultural and Technical Departments in the Colonies and India.

CYPRUS.

Journal, 1910, No. 19.—The soy bean (states that cultivation trials are being made with this bean in the Island)—Regulations affecting the importation of plants, seeds, etc., into Cyprus—Preventive measures against "phylloxera" (a note on the measures adopted in France and Tunis).

RHODESIA.

Agricultural Journal, 1910, 7. No. 6.—Standard types of Rhodesian maize and their points (illustrated)—Farms and farming in Rhodesia (a description of the Insiza District)—Bat guano (gives analyses of three Rhodesian samples).

EAST AFRICA PROTECTORATE.

Agricultural Journal, 1910, 3. Part 1.—Account of a tour in the cotton belt of the United States (Mr. P. H. Lamb, now chief Agricultural Officer in the Uganda Protectorate, spent several months in 1909 in touring through the cotton districts of the United States with the object of investigating the production of Upland cotton and the methods of handling this product. In this paper he gives an account of his observations, devoting attention particularly to Sea Island and long-staple Upland cottons. He concludes that whilst the United States is probably capable of meeting the world's demand for ordinary Upland, its capacity for producing the finer kinds is very limited)—Notes on stock diseases of East Africa and Uganda, and the Resolutions of the International Veterinary Congress held at the Hague in 1909—Maize for export (a paper by the Director of Agriculture, pointing out that the Government is anxious to develop an export trade in this product, and that to guard against the export of weevilled, insufficiently dried, or otherwise unsatisfactory grain, a system of grading has been instituted by the Agricultural Department)—Seed selecting and testing (a method of testing the germinating power is described, and methods of selection are outlined for maize, beans, peas, and potatoes)—Entomological notes—Bean anthracnose (enumerates the symptoms of the disease and suggests remedies)—Experiments in tapping Ceará rubber trees (reprinted from the *Bulletin of the Hawaii Experiment Station*)—"Ebony" (*Dalbergia melanoxylon*) (a sample of this timber has been valued by a Sheffield firm at £5 per ton, which is somewhat lower than a valuation obtained by the Imperial Institute in January 1909, for a sample of the same wood in London—A report by the Imperial Institute on beans grown in the Protectorate is also given (see this *Bulletin*, 1910, 8. 252).

UNION OF SOUTH AFRICA.

Agricultural Departments.

TRANSVAAL.—*Agricultural Journal*, 1910, 9. No. 33.—The production of maize in Free State Province—Maize in Rhodesia—Co-operative manurial experiments on maize—Analyses of bat guano, destructor ash, ash from coal-mine dump, and town refuse (the possible manurial value of these materials is discussed)—The "Uba" sugar-cane (this cane does well in South Africa, and is suggested as a satisfactory parent stock for

the development of new breeds by crossing)—Measurement of maize seed ears (a long series of measurements is given to serve as a guide to farmers in selecting maize for sowing)—Cotton (continued from the previous number)—Dry land cultures.

NATAL.—*Agricultural Journal*, 1910, **15**. No. 2.—The growing and preparation of wool for the South African market—South African wool from a buyer's and manufacturer's point of view. No. 3.—Soy beans (an illustrated article describing the cultivation and uses of soy beans). No. 4.—Mealie grubs (the insect pests which most seriously affect the maize plant in South Africa are three moth caterpillars, commonly known as "grubs" or "worms." Illustrated descriptions of these are given with notes on the damage done by them, and methods of controlling the pests are indicated)—"Peach leaf curl" (a descriptive account of the diseases, for which spraying with Bordeaux mixture, some days before the blossoms open, is recommended)—Selection and judging of maize—The cultivation of chicory (gives an account of a series of manurial experiments with chicory at the Winkelspruit Experimental Farm).

CAPE OF GOOD HOPE.—*Agricultural Journal*, 1910, **37**. No. 2.—Experiments with ostriches, XIV. (deals with the principles underlying ostrich breeding)—"Bitter pit" (an illustrated description of this apple disease; selection of varieties immune to the disease is recommended)—Directions for the cultivation of cotton—Agricultural Zoology for South African students—Co-operative experiments (gives results of trials with varieties of rape, mangolds, turnips, linseed, chicory and carrots). No. 3.—Relative rust resistance and yield of various varieties of wheat and oats—A preliminary note on Cape buchu leaves (describes the present position of this industry in the colony, and deals with the collection and preparation of the drug for the market)—Annual sale of Turkish and Virginian tobaccos (at a public sale of these two kinds of tobacco grown in the colony, held on August 5 last, 66 bales of Turkish and 38 of Virginian tobacco were offered. The former realised from 1*s*. 10*d*. to 3*s*. 6*d*. per lb., and the latter from 4*d*. to 10*d*. per lb)—Amarantus weed (a description of this noxious weed is given, with suggestions for its eradication)—Moisture in export maize (as the result of investigations conducted in the colony and in London, it is recommended that maize for export should not contain more than 12 per cent. of moisture. The Brown-Duvel moisture tester is recommended for use in testing the wetness of maize at South African ports)—Experiments with ostriches, XV. No. 4.—Cape hides and skins (a report by the Acting Trades Commissioner on a trial consignment sent to London. It contains criticisms by experts in London on the preparation and packing of the hides and skins, and suggestions from experts in London and Hamburg as to the better preparation of these products for the market)—"Apple bitter rot" (this fungus, *Glomerella rufomaculans*, has recently been the subject of investigation at the instance of the Under-

Secretary for Agriculture, and has been found in the Humansdorp and George districts, affecting apples, and it probably also occurs in other parts of the colony. The method of distribution is described, with notes on the damage done, and, finally, the means to be adopted in eradicating it are given, mainly from bulletins of the United States Department of Agriculture on this subject)—The principal diseases of our vineyards (a monograph by the Government Viticulturist describing the diseases and methods of combating them)—The fruit export trade (a report by the Trades Commissioner dealing with the export of fruit in the season 1910)—"Calandra" of the vine (spraying with arsenate of lead is recommended)—Alleged cures for snake-bite (it is stated that all the native "snake-bite cures" submitted for trial have proved worthless on investigation. Experiments have been made recently by the Director of the Port Elizabeth Museum with a plant product known as "zibiba" or "sebiba," which is regarded by native doctors as an infallible antidote for snake-venom, but the material proved useless in the case of monkeys bitten by the "Brown Cape Cobra," and admixture of the product with snake-venom appeared to have no effect on the toxic properties of the latter).

Mining Departments.

TRANSVAAL.—*Final Report of the Mining Regulations Commission*, 1910, Vol. I.—Gives a large body of valuable evidence and recommendations relating to the health conditions in mines, ventilation, and mining regulations. The Commission has proved that rock drillers suffer a very high rate of mortality due to miners' phthisis. The most important factor in the production of this disease is the inhalation of irritating dust arising from drilling and blasting operations. The average period of rock-drill employment is from seven to nine years, and the average age at death from silicosis is 35 years, as compared with about 50 years at Bendigo, where, however, the incidence of the disease is much higher. The Commission points out that the inhalation of dust can be prevented by the free use of water during dust-raising operations; and that this use of water should be rigorously insisted upon when the strata worked are in a dry condition. Ankylostomiasis, or the miners' worm, on the other hand, causes very little trouble amongst the white miners on the Rand. This is attributed to the comparative dryness and coolness of the workings, and the acidity of the mine water. It has been found that at least 80 per cent. of the native mine labourers from all parts of South Africa, except the Basutos and Damaras, are infected with bilharzia, a trematode worm found in most South African rivers. Not only do the natives suffer directly from this disease; they suffer also from breathing the ova of the worm, which are very irritating to the lungs. These ova, which are often calcified, act not merely as a predisposing cause of pulmonary disease, but may even be the sole cause of consolidation of the lung in certain

forms of pneumonia. The Report has numerous appendixes, one of which includes an account of a visit to the Premier diamond mine, and a brief description of the method of working there.

Miscellaneous.

TRANSVAAL.—*Report of the Government Laboratories*, 1908–1909.—The analytical work done was mainly of a routine character for various Government Departments, but it is noted that several samples of Transvaal coals were examined and proved inferior to imported British coal for steam-raising. Four samples of Transvaal iron ores gave results varying from about 20 to 77 per cent. of iron oxides, with traces in most cases of phosphorus and sulphur, and from 16·to 45 per cent. of silica, and in one case a trace of chromium sesquioxide. Several specimens of iron made locally contained 94·3 to 97·5 per cent. of iron with traces to 0·24 per cent. of titanium, and in one case considerable percentages of silicon, carbon and phosphorus.

South African Central Locust Bureau. Fourth Annual Report of the Committee of Control.—The organisation of this Bureau and its methods of work were briefly described in a notice of the Committee's Third Report (this *Bulletin*, 1910, **8**. 67). The present report is compiled on the usual lines. During the locust season of 1909–10 damage by the red-winged locust was almost confined to a part of Mozambique, and no "voetgangers" (hoppers) of this species were reported from Cape Colony or the Transvaal. The brown locust was present to a slight extent in German South-West Africa, and did serious damage in the south-western districts of the Orange River Colony and in Cape Colony, which was invaded by swarms from the Kalahari Desert in March 1909. The preventive measures used have been mentioned already (*loc. cit.*), but during the present year great success has attended the use of poisoned bait (cut forage, etc., soaked in a sweetened solution of sodium arsenite) in the Orange River Colony, and in addition birds preying on locusts were very plentiful over the whole of the territory controlled by the Bureau. A number of storks, which had been marked in Hungary and Germany in the course of the international investigations on the migration of birds, were found during the year in South Africa, and the report points out that these investigations may have a very important bearing on the question of locust control, since there seems to be little doubt that migratory locust birds are a leading factor in the control of migratory locusts.

BRITISH WEST AFRICA.

SOUTHERN NIGERIA.—*Report on Entomological Work*, 1909.—A Government Entomologist was appointed to the Agricultural Department at the beginning of 1909, and this report details the work already done and the steps taken to ensure effective work on economic entomology in the future. A useful classification of insects into (1) those

injurious to vegetation, (2) those injurious to man and animals, and (3) beneficial insects, is first given, the most important groups in each class being indicated. Notes on some insects observed during the year are then given, with descriptions in some cases, and information as to the economic plants they affect, particular attention being devoted to insects attacking cocoa, cotton, maize, ground nuts, citrus trees, *Funtumia elastica* and palm trees. Two special reports dealing with insects attacking (*a*) cotton and (*b*) cocoa are included. In these the more important injurious insects are described in some detail so that they may be readily recognised, and, where possible, methods of destroying the insects are given. At the end of each report a short summary is printed containing a few simple rules for the prevention of insect attacks and emphasising the importance, from this and other points of view, of clean cultivation.

GOLD COAST COLONY.—*Agricultural Department Report*, 1909.—The cultivation of cocoa continues to expand rapidly throughout the colony and Ashanti. Unfortunately this development has been attended with the introduction of insect and fungoid pests, which are already causing serious damage, and in spite of the efforts of the officers of the Department, it is difficult to get the majority of the native farmers to take adequate steps towards clearing their plantations of disease. The quality of cocoa exported is stated to show considerable improvement over that of previous years, and it is believed that in the near future the better qualities will fetch as high a price as good West Indian.

Tapping experiments on Para rubber trees were undertaken at the Aburi and Tarquah Stations. At the latter place the yield from 38 trees 5½ years old, with an average girth of 24 inches, was 5 lb. 14 oz. of dry rubber, after twelve cuts had been made. The rubber trees at Tarquah and Coomassie Stations have been attacked by a fungus (*Rosellinia* sp.), and about 150 trees have been destroyed. The soil in the neighbourhood of the remaining trees has been treated with lime, and a system of clean cultivation introduced. *Funtumia elastica* appears to be popular with native farmers, and 2,274,000 seeds of this species were distributed for planting during the year. Soy beans were tried, but they did not grow successfully; the best yield was 472 lb. per acre, obtained at Aburi, but further trials are being made this year. Reference is made to the investigation of Gold Coast oil palm fruits carried out in conjunction with the Imperial Institute and the Royal Gardens, Kew (this *Bulletin*, 1909, 7. 366), and it is mentioned that the thin-shelled oil-palm of the Gold Coast has now been identified definitely as *Elaeis guineensis*, var. *microsperma*. Cultivation experiments are being made with this variety and also with the so-called seedless kind, and with "Lisombe," "Divaka-waka," and "Gewohnsuhe," the last three having been imported from the Cameroons.

It is proposed to devote special attention to the production of coprah,

and the planting of coconuts by natives is being encouraged, *e.g.* by the formation of a small plantation at the Assuantsi Agricultural Station. The remainder of the Report gives an account of the tours of inspection made during the year, and particularly of the observations made in the course of these tours on fungoid and insect pests attacking cocoa, oil-palms and rubber. Details of the work done at the five agricultural stations are printed in a series of appendixes.

SEYCHELLES AND MAURITIUS.

SEYCHELLES.—*Report on the Botanic Station, Agriculture and Crown Lands*, 1909.—A copy of this Report has been supplied to the Imperial Institute by the Colonial Office, and from it the following summary has been prepared. A lengthy summary of the Report for 1908 was printed in this *Bulletin* (1909, 7. 394), and the present Report follows very much the same lines as the previous one.

The economic plants sold to planters included Para and Funtumia rubbers, Sisal hemp, ylang-ylang, eucalyptus and cedars. The newly-acquired Crown Lands above the St. Louis Reservoir have been re-afforested, so that altogether 8,638 trees have been set out in the new forest since June 1908. In the Botanic Garden itself an avenue (900 feet × 20 feet) has been made, and it is proposed to plant this alternately with *Parkia Roxburghii* and "Coco de mer," using for the latter "female" nuts on one side of the avenue and "male" nuts on the other, in order to test the local belief that nuts with a deep sinus in the middle produce "female" trees.

In spite of a specially dry season the coconut crop was greater than that of 1908 by 1,015,797 nuts, due partly to increase in the area cultivated, and partly to the greater attention now paid to the culture of this palm. The high price ruling for coprah (averaging 52·41 francs per 100 kilos in Marseilles, an increase of 7·79 francs on that obtained in 1908) induced planters to consider the question of manuring the coconut palms, but so far this has been done in a rather haphazard manner. Taking the results of analyses of coconut palm products, published in Mauritius, as a basis, and allowing 100 trees per acre, it is estimated that the loss per acre, per annum, of materials serving as plant food is as follows:—phosphoric acid 11, nitrogen 18, potash 26, soda 59 and lime 38 kilos, assuming that the leaves and spathes are left on the ground and that half of these became available as manure, the husks and shells, however, being removed. To compensate for this loss it is suggested that about 100 kilos of guano, 100 kilos of potassium sulphate, and 80 kilos of ammonium sulphate or dried blood should be applied per acre, though these amounts should be slightly increased on granitic soils, which also need the addition of lime to prevent them becoming acid. The manure should be applied, as far as possible, evenly over the ground, and not dug in deeply. The improved varieties of coconut palm brought from Ceylon and Java have fruited this year,

within six years of the date of planting. While nuts from local varieties as a rule produce only about 280 lb. of coprah per 1,000 nuts, those from the improved varieties yield as much as 500 lb. To encourage the cultivation of better types it is suggested that local buyers should pay enhanced prices for larger nuts, as is done elsewhere.

The vanilla crop for 1909 amounted to 11·25 tons, compared with 24·75 tons in 1908 and 66·5 tons in 1907, the smaller yields in the two last years being due mainly to exhaustion of the vines by the heavy crop of 1907. Planters are recommended in future not to allow a vine to mature more than from 30 to 50 pods, according to its vigour, in order to avoid the weakening which results from over-cropping. The manuring experiments referred to in last year's Report (*loc. cit.* p. 396) are being continued.

Plantations of vetiver (50 acres), ylang-ylang (60 acres), lemon grass (50 acres), and cloves (25 acres) have been made this year, and 555 litres of clove oil and 28 litres of cinnamon bark oil were exported, though the great bulk of the cinnamon is still exported in the form of bark (1,043 tons in 1909). One planter has started the manufacture of citrate of lime, a few samples which contained 64 per cent. of citric acid being favourably received on the London market.

The total number of Para rubber trees planted in the colony is 59,148, of which 26,700 were bedded out during 1909. Rubber tools have been imported from Ceylon, and it is proposed to tap experimentally this year 500 trees, which are 6 years old and 18 inches in girth. The prospects of the rubber industry are considered distinctly promising, since although the trees do not attain the dimensions of those in the Malay Peninsula, they compare favourably with those grown on rocky ground in Ceylon, and moreover are comparatively free from the attacks of parasitic insects.

An order has been received at the Botanic Station for 60,000 Sisal hemp plants, and it is considered that this plant, and also Mauritius hemp, should do well in the colony, and in this connection a brief account of the hemp industry in Mauritius is given (see this *Bulletin*, p. 265)

The exports from the outlying islands included 17,483 tons of guano and nearly 9 tons of mangrove bark, but the export of the latter is greatly impeded by poor shipping facilities. A new deposit of guano was located on Assumption Island during the year, and analyses show that it is of high grade, containing calcium phosphate equivalent to 34·0 per cent. of phosphoric acid.

MAURITIUS.—*Station Agronomique, Bulletin*, No. 22.—This constitutes the annual report for 1909, and details the experimental work carried out in the laboratory during the year, mainly analyses of sugar-cane and its products, and of manures. Information is also given of the condition of the sugar industry during the year and of the results of trials with new varieties. "Macadam," a forage made from the

heads of sugar-canes, is largely used in the dry season. Analyses prove that the nutritive value of this material is low, so that it should be used in conjunction with richer fodders, especially seeds containing a large proportion of nitrogen. *Canavalia ensiformis*, the "sword bean," is recommended for trial as a fodder, and analyses are given of the pods and seeds grown on different soils. Soy bean (*Soja hispida*) is also considered likely to grow well in Mauritius. Analyses are given of sixteen varieties of rice grown in the island, with an account of the conditions of growth.

INDIA.

Agricultural Departments.

Imperial Department. Memoirs, Botanical Series, 1910, **3.** No. 3. *Studies in Indian Fibre Plants*, No. 1. *On Two Varieties of Sann*, Crotalaria juncea, L.—It has been found that (1) the Sann hemp plant of the Central Provinces differs from (2) that grown in the neighbourhood of Pusa, particularly in the following ways. The seeds of (1) are large, and dull black or greyish; those of (2) are small, black and shiny. The seeds of (1) germinate rapidly, producing large seedlings with green, glabrous, cotyledonary leaves and stems; those of (2) germinate slowly, producing small seedlings with reddish, downy, cotyledonary leaves and stems. The mode of branching is a characteristic feature; (1) is tall, branches at about 8 feet from the ground, giving a few erect, parallel shoots with little or no secondary branching, and bears but few flowers and seeds; (2) is short, branches at about 4 feet from the ground, has many, long, spreading branches with secondary and sometimes tertiary offshoots, and bears an abundance of flowers and seeds. The Central Provinces variety flowers much earlier than the Pusa form. The results of comparative experiments show that, on the whole, the Central Provinces variety is preferable to the Pusa form as a green manure, especially if the sowings have to be made early. Green manuring with *Crotalaria* is stated to have been found of great benefit for tobacco cultivation. The fibre obtained from the Central Provinces plant is superior to that from the Pusa variety, especially in strength and durability. No. 5.—The "bud rot" of palms in India (a monograph describing the area affected by the disease, its seasonal prevalence, symptoms, and methods of control).

Entomological Series, 1910, **2.** No. **8.** *Life-Histories of Insect Pests. Coleoptera, I.*—Descriptions of some of the following common Indian beetles are given, with details of their life-histories, and are illustrated by coloured plates. *Phyllognanthus dionysius* (Fabr.) has been observed in Belgaum, Bombay Presidency, attacking the roots of rice seedlings and inflicting considerable damage. *Anomala varians* occurs commonly at Pusa; it feeds on the roots of plants and caused serious injury to the ground-nut crop in 1904. This insect has also been found at the roots of millets and sugar-cane in Gujarat and Behar. *Galerucella*

singhara (the "singhara" beetle) is a pest of the aquatic "water-nut" or "singhara" plant (*Trapa bispinosa*), grown in the Indian plains as a food-crop. *G. rugosa* (Jac.) infests semi-aquatic species of *Polygonum*. *Apomecyna pertigera* (Thoms.) has been noticed boring into the stems of the pumpkin (*Lagenaria vulgaris*), largely cultivated in India as a vegetable, but does not seem to cause much damage. *A. histrio* has been found boring in the stems of a wild creeper (*Tinospora cordifolia*). *Cyclas formicarius* (Fb.) is a formidable pest of the sweet potato, and occurs in all parts of India in which this crop is grown. *Cionus hortulanus* (Fourc.) var. *major* passes its life on *Celsia coromandeliana*, a common weed of Pusa.

Agricultural Journal, 1910, **5**. Part 4.—A problem in agriculture (the Inspector-General of Agriculture draws attention to the importance of a solution being found for the problem of reclaiming the alkali lands of India)—"Shauk-noo" (*Citrus hystrix*)—The present position and prospects of cotton cultivation in India—A report of the first entomological demonstration made in Baroda, 1909–10 (an account of a practical demonstration to cultivators of methods of controlling the cotton bollworm)—Cultivation of "guinea grass."

Second Report on the Introduction of Improvements into Indian Agriculture.—In the first report on this subject (this vol., p. 191), the various methods were enumerated by which attempts are being made by the Agricultural Departments of India to introduce improvements into Indian agriculture. In the present report, the different ways of approaching the cultivators are further discussed and amplified. It is considered that progress is being made in this direction, that the methods are becoming more definite, and that the conditions likely to lead to success are being more clearly recognised.

Agricultural Research Institute, Pusa. Bulletin, No. **18**. *Report on the Outbreak of Blister Blight on Tea in the Darjeeling District in* 1908–09.—Blister blight first appeared in the Darjeeling District in 1908, and has since extended rapidly with serious results. The disease is caused by a fungus (*Exobasidium vexans*, Massee). A full account is given of this pest and recommendations are made with a view to its eradication. The pamphlet is well illustrated.

BENGAL.—*Quarterly Journal*, 1910, **4**. No. 1.—Cultivation of soy beans in India (describes the procedure to be followed, and states that a yield of 500 to 1,000 lb. of grain per acre may be obtained in a good year—A note on the value of green manuring and summer fallows (a series of results obtained in laying out the Botanic Garden at Sabour, from which it appears that increased yields of grass were obtained from land which was green manured with Sann hemp, and deep cultivated during the summer)—Sericulture in Bengal (an account of recent work undertaken with a view to the improvement of the industry)—Diseases and pests (describes the "rice hispa" a small bluish-black beetle which feeds on rice leaves; and the "rice-fulgorid,"

a small whitish insect which sucks the sap from rice leaves).—For the destruction of the former, systematic sweeping of the field with bags is recommended, and for the latter, the pouring of kerosene on the standing water in the rice fields. Illustrations of the insects are given.

MADRAS.—*Central Agricultural Committee. Bulletin*, No. 4. *The Use of Prickly Pear as Fodder.*—An account is given of certain feeding trials which have been made in India with prickly pear. It is considered that this cactus might form a useful adjunct to the fodder resources of the country, and that it would be a valuable auxiliary food in times of famine (compare this *Bulletin*, 1908, 6. 314, and 1910, 8. 43).

Proceedings and Progress Report, 1910.—A summary is given of the work for the half-year, ending June 30, 1910, of the District Agricultural Associations at Ganjam, Vizagapatam, Godavari, Kistna, Guntur, Kurnool, Anantapur, Pudukkotai, Trichinopoly, Coimbatore, Malabar and South Canara. The cultivation of Cambodia cotton is extending rapidly in the Tinnevelly District. Higher counts of yarn can be spun from this variety than from any indigenous Madras cotton, and, if the crop is manured and occasionally watered, it gives very large yields. In 1907–08, jute was successfully grown in the Godaveri District, but the cultivation has now been abandoned since it is less profitable than that of rice. Trials have been made with many other crops, and the results are recorded.

Lyallpur Agricultural Station. Annual Report, 1909–10.—Experiments have been made with various types of cotton, including American Upland, Egyptian, and indigenous varieties. On the whole, the results were satisfactory, the American kinds being valued in Liverpool at prices ranging between 7·75*d*. and 8·25*d*. per lb. The Egyptian cottons gave poor results, as in the case of previous trials. Considerable attention was devoted to wheat, no less than 200 sowings being under observation during the year. Twenty varieties of Australian wheats were grown, but the yields were not so good as those of indigenous kinds. Selection of indigenous wheats has been continued, and a series of hybridisation experiments was made with the object of increasing the percentage of nitrogen in the best yielding and milling varieties and of strengthening the straw. An investigation has been carried out to determine the suitability of cassava (*Manihot utilissima*) as a crop for the Punjab, and it has been found, (1) that cassava must be planted as soon as the winter frosts are over, (2) that with a fair supply of water, the sub-aërial parts of the plant grow vigorously, but the yield of roots is much below the normal amount, and (3) that white ants are exceedingly destructive to the young plants. This crop cannot therefore be recommended to cultivators at present. Experiments on jute cultivation have shown that the plant can be grown successfully, but that, owing to the high price of labour, there is little prospect of this crop being adopted by the cultivators until machinery has been devised to extract the fibre. The respective

merits of Sann hemp (*Crotolaria juncea*) and jute as crops for the Punjab are compared.

Forest Departments.

Forest Pamphlet, No. 15. *Forest Zoology Series*, No. 2. *Note on the Preservation of Bamboos from the Attacks of the Bamboo Beetle or "Shot-borer."*—The value of bamboos in India for building or manufacturing purposes is much reduced by the fact that they are subject to the attacks of the bamboo beetle or "shot borer" (*Dinoderus minutus*, Lesne). In many parts of the country the probable life of a bamboo after being cut is only about 1–1½ years, owing to the ravages of this pest. A description of the beetle is given together with an account of its life-history, and experiments are described on treating bamboos with preservatives in order to protect them against the pest. The best results were obtained by soaking the bamboos in common Rangoon oil. Copper sulphate was found to be useless for the purpose.

MADRAS.—*Administration Report* 1908–09.—The total area of State Forests at the close of the year amounted to 19,570 square miles, consisting of 18,694 square miles of reserved forests and 876 square miles of reserved lands. In the Northern Circle, experiments have been conducted with sandalwood, mahogany, red sanders, teak, logwood, catalpa, coconut, rubber, and other trees. In the Central Circle, trials have been made with various plants, including *Agave Ixtle*, *Cæsalpinia coriaria*, *Eucalyptus* sp., *Swietenia macrophylla*, several Australian grasses, mahogany and sandalwood, whilst in the Southern Circle attention has been devoted to *Swietenia Mahogani*, *S. macrophylla*, *Cedrela odorata*, *Pinus insignis*, *Catalpa speciosa*, bamboos, camphor, and other plants. The output of timber during the year amounted to 3,374,382 cubic feet, and that of fuel to 21,041,192 cubic feet, as compared with 3,717,618 cubic feet of timber and 22,637,072 cubic feet of fuel in 1907–08. Bamboos were collected to the number of 32,601,730 as compared with 44,657,836 in 1907–08.

UNITED PROVINCES.—*Administration Report, Western and Eastern Circles*, 1909–10.—The total forest area on June 30, 1910, amounted to 8,475,974 acres or about 13,244 square miles, consisting of 1,285,632 acres in the Western Circle, 1,386,295 acres in the Eastern Circle, and 5,803,867 acres of District Protected Forests. In the Naini Tal Division of the Western Circle, experiments have been made with the object of improving the quality of resin and turpentine. Although this work has demonstrated that the products can be obtained in a much purer condition than is usual at present, it is not anticipated that any commercial advantage will accrue, as the trade appears to prefer the less pure forms. Experimental cultivation of lac has been continued, but without much success. In the Naini Tal and Jaunsar Divisions, 188,849 pine trees were tapped, and yielded 11,743 cwt. of crude oleo-resin, equivalent to about 7 lb. per tree. The total

output of timber amounted to 7,810,015 cubic feet, of which the Western Circle contributed 2,213,448 cubic feet, the Eastern Circle 2,722,445 cubic feet, and the District Protected Forests, 2,874,122 cubic feet. The total quantity of fuel collected was 11,564,550 cubic feet, of which 5,077,522 cubic feet were obtained in the Western Circle, 6,384,230 cubic feet in the Eastern Circle, and 102,798 cubic feet in the District Protected Forests.

CENTRAL PROVINCES.—*Report on Forest Administration*, 1908–09.—In the Northern Circle, measures have been taken to check the spread of *Loranthus*, and experiments are being made in growing *Catalpa speciosa*. In the Southern Circle, the "chir" pine (*Pinus longifolia*) is being experimentally cultivated in the hope of assisting the regeneration of "sal" (*Shorea robusta*) in frost holes. Lac propagation is being carried out on a large scale in the Raipur Division, but the results so far have been disappointing. Experiments on the conversion of seed-lac into shell-lac by means of methyl alcohol have given very satisfactory results. In the Berar Circle, efforts are being made to propagate bamboos, and a nursery has been started at Yeota in the Akola Division. Sericultural experiments have been carried out in the Betul Division, where the local industry appears to be moribund. Extensive operations for the propagation of lac were undertaken in the Nimar and Betul Divisions, but were not successful from a financial point of view.

Geological Survey.

Records, 1910, **39**. Part 1.—Quinquennial review of the mineral production of India during the years 1904 to 1908. The value of coal produced annually, increased from £1,398,826 to £3,356,209; that of petroleum from £473,971 to £702,009; of manganese ore from £142,443 to £517,166, after reaching in 1907 the sum of £1,361,996; and of mica from £83,183 to £139,513. Less remarkable increases occurred in the cases of salt, saltpetre, jadestone, iron ore, tin ore, and chromite. The output of magnesite after falling from £351 in 1904 to £50 in 1907, rose in the succeeding year to £2,009. On the other hand decreases took place in gold, gems and amber. The progress of Indian mineral industry is detailed at considerable length, and comparisons are drawn with other countries.

Great interest attaches to the prospects of iron-smelting in India, though the total value of the output in 1908 amounted to only £15,149. As is well-known this industry has been carried on for at least two thousand years by native workers, by whom excellent iron and steel are produced, and it is remarkable that since 1905 there has been a steady increase in the number of native furnaces in the Central Provinces, viz. from 276 to 626. Hitherto the only operations on European lines were those of the Barakar iron works, but the Tata Iron and Steel Company is now commencing operations in the Singhbhum district of Chota Nagpur.

The set-back in the output of manganese is probably only temporary as there appears to be no country that can produce the ore more economically than India; certainly not Brazil, with the milreis ranging between a minimum of 15*d.*, secured on a gold basis, and 16*d.* In table 60, however, we are given to understand that the value of "1,000 milreis" varies from 7*d.* to 14*d.*, which is certainly wide of the truth, even if "1,000 reis" is intended.

Among the less common mineral products may be mentioned the occurrence of nickel in pyrrhotite, and other minerals in Tobala Taluk in Southern Travancore and elsewhere. This metal is largely used in India in the form of German silver, and a one-anna nickel coin has recently been issued, but the supplies are all obtained from outside sources. Important beach deposits of monazite (the chief source of the thoria of incandescent gas mantles) have recently been found on the coast of Travancore, and analyses of this material made at the Imperial Institute show that the monazite approaches that of Ceylon in its richness in thoria.

Miscellaneous.

Note on the Production of Coffee in India in the Year 1908–09.—The cultivation of coffee in India is almost entirely confined to Southern India. A small quantity is grown in Burma, Assam and Bombay, but, as the aggregate area and yield only averaged 250 acres and 8,800 lb. during 1903–07, the returns for these Provinces have been discontinued. The following figures therefore relate to Southern India only. The areas under cultivation during the year 1908–09 were as follows: Madras, 52,691 acres; Mysore, 102,903 acres; Coorg, 44,316 acres; Travancore and Cochin, 4,687 acres, making a total of 204,597 acres, as compared with 208,795 acres in 1907. The total production of coffee in the year under review was estimated at 27,648,357 lb., and the exports in the calendar year 1909 amounted to 23,625,504 lb., of which 10,045,392 lb. were shipped to the United Kingdom. The area under coffee in 1908–09 was 86 per cent. of that in 1885–6, whilst the exports were only 52 per cent.

Note on the Production of Tea in India in the Year 1909.—The areas under tea cultivation during 1909 were as follows: Eastern Bengal and Assam, 437,804 acres; Bengal, 53,469 acres; Northern India (United Provinces and Punjab), 17,442 acres; Southern India (Madras and Travancore), 44,897 acres; Burma, 1,693 acres, making a total of 555,305 acres as compared with 548,127 acres in 1908. The total production of tea in 1909 amounted to 262,560,668 lb., which is 15,654,589 lb. in excess of the 1908 crop. The different parts of India contributed as follows: Eastern Bengal and Assam, 227,095,140 lb.; Bengal, 13,165,788 lb.; Northern India, 3,620,331 lb.; Southern India, 18,679,409 lb. In Burma, 242,045 lb. of "letpet" (wet pickled tea, used as a condiment) were produced, and only 4,230 lb. of black tea. The production of green tea in India in 1909 amounted to

2,677,993 lb. The total exports of tea for the year 1909–10 were 250,521,064 lb., of which 189,368,907 lb. were shipped to the United Kingdom. It is noteworthy that whilst the area under cultivation has increased since 1885 by 95 per cent., the increase in production has been no less than 267 per cent.

Indian Trade Journal, 1910, **18**. No. 230.—Agricultural implements for the Central Provinces (the staple crop in the area is wheat, and the agricultural machinery needed for this crop, and for which a demand already exists or is likely to be created, is considered). No. 232.—Sugar manufacture in the Punjab. No. 233.—Agricultural implements for India (outlines the assistance rendered by Provincial Governments towards the introduction of improved agricultural implements, and refers to existing facilities for the manufacture of this machinery in India). Vol. **19**. No. 336.—Mining in India, past and future (an account of mining methods as formerly practised in India, with notes on the possibility of extending mining in the future).

CEYLON.

Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, 1910, **5**. No. 7.—Report on the outbreak of *Achatina fulica* (records the effect of attacks by this snail on economic plants in the Beruwala district). No. 8.—A root disease of Hevea (a description of *Sphærostilbe repens* with notes as to the characteristic symptoms of the disease and suggestions for its treatment). No. 9.—On the effect of different intervals between successive tappings in Para rubber (*Hevea brasiliensis*). No. 10.—Root diseases of *Acacia decurrens*. No. 11.—Root diseases of tea.

Tropical Agriculturalist, 1910, **35**. No. 2. — The Heneratgoda experiments, 1905–06 (a detailed analysis is given of the results of tapping trials with Para rubber trees at Heneratgoda in 1905–06, in the course of which it is shown that the results obtained in these trials do not safely admit of the deductions drawn from them by Wright, and more recently by Parkin, *Science Progress*, 1910, No. 16) — Entomological Notes (deals with Castilloa scale bug, protection of rubber trees against rats, a pest attacking coca, etc.)—Miscellanea: chiefly pathological (various notes on tapping rubber trees)—Literature of Economic Botany and Agriculture (the entries in this portion relate to "rubber") —Ceylon Agricultural Society (Progress Report, No. 50, containing information regarding tobacco experiments at Maha-Illuppalama, and analyses of *Tephrosia purpurea* and *Crotalaria juncea* suggested as "green manures"). No. 3.—Experimental tapping of Hevea at Singapore (a criticism of the results of experimental tappings made recently at Singapore and recorded in the Straits Bulletin for July last)—Weak rubber (a note criticising Parkin's view (*loc. cit.*) that weakness in rubber from young trees may be due to the latex being largely derived from primary growth instead of from secondary growth, as in old trees)—

Entomological notes—Miscellanea: chiefly pathological—Literature of Economic Botany and Agriculture (entries relating to rubber cultivation, tapping, preparation, manufacture, trade, diseases). No. 4.—Entomological notes (contains *inter alia* a note on the "cheroot beetle," *Lasioderma testacea*, which attacks stored tobacco. Fumigation of the warehouses and sheds with carbon disulphide is recommended)—Ceylon Agricultural Society, Progress Report, No. 51 (the Superintendent in charge of the tobacco experiments at Maha-Illuppalama reports that the Java and Sumatra tobacco under trial have grown well, and some of it has already been picked and fermented, and a crop of 20,000 lb. of dry tobacco is expected this year. A trial shipment of 1,000 lb. of Trincomalee tobacco has been sent to Europe for sale. At the suggestion of the Director of the Imperial Institute an attempt is to be made to introduce the lac insect into Ceylon and to try it on *Pithecolobium Saman* as a host tree: see this *Bulletin*, 371)—Literature of economic botany and agriculture (this section continues entries relating to rubber; Castilloa, Cryptostegia, Funtumia, Hevea, Landolphia, Manihot, Mascarenhasia, Parthenium, Sapium and "sundry genera" being the sections enumerated)—Recent progress in tropical agriculture (the first of a series of lectures delivered at Harvard University by the Director of the Botanic Gardens, Ceylon)—The Agricultural Society's tobacco experiments at Maha-Illuppalama (it is pointed out that the object of this experiment is the production of tobacco suitable for export to Europe, and that consequently the varieties under trial, viz. Sumatra and Java, are those for which there is already a market in Europe. The methods of cutting and preparing the tobacco which have so far been in vogue in Ceylon do not yield a product that meets European requirements, and in carrying out the present experiments new methods have had to be introduced).

STRAITS SETTLEMENTS AND FEDERATED MALAY STATES.

Agricultural Bulletin, 1910, 9. No. 8.—Third report on experimental tapping of Para rubber trees in the Botanic Gardens, Singapore (continued from the previous number. This portion deals with the pests of Para rubber, giving an account of *Fomes semitostus*, *Diplodia rapax*, *Eutypa caulivora*, and adds a note on a new fungus attacking *Hevea* sp. in Surinam. It is also mentioned that Para seedlings in nursery beds are frequently attacked by mites) — Malay camphor (describes *Dryobalanops Camphora*, records its distribution in Pahang, mentions that this species yields a good timber, furnishes a camphor, an oil of camphor, and a dammar-like resin, whilst the bark is used by the natives in the construction of houses)—Further notes on Malay camphor (points out that the camphor from *Dryobalanops Camphora* was the first kind of camphor which appeared in commerce, and states that it is still used in funeral rites by the Chinese and the Battaks). *Manihot dichotoma* (mentions that of twelve seedlings planted on the

Sengat Estate in May 1909, all have grown well, their heights ranging from 13 feet 6 inches to 17 feet 6 inches, and their girths, at three feet from the ground, from 4 to 7·5 inches. The plants are inclined to be top-heavy, but it is suggested that this could be avoided by closer planting). No. 9.—Rubber fungi (a lecture delivered by the Director of the Botanic Gardens in the Straits Settlements, at the Singapore Agricultural Show—Pineapple as a catch-crop in rubber cultivation—Rubber cultivation in Cochin China. No. 10.—The Agricultural Show (list of exhibits at the recent Singapore show with notes on their quality)—Peat soils (gives analyses of typical peat soils in Johore, with notes on the manures required by them).

FEDERATED MALAY STATES.—*Department of Agriculture. Bulletin* 1910, No. 11.—Coconut cultivation in the Federated Malay States (gives details of the cost of land, areas suitable, the preparation of the soil, selection of seed, formation of nurseries, suitable catch-crops, method of planting, the maintenance of plantations, methods of manuring, the preparation of copra, methods of dealing with pests, and finally an estimate of expenditure up to the sixth year and of returns from the sixth to the ninth year inclusive).

Federal Reports, 1909.—The reports of technical interest are those on mines, geology, forests, agriculture, medical research, museums and fisheries. The report on the mining industry is mainly statistical, and gives particulars of development in the mining of tinstone, gold and wolfram.

The Geologist reports that a geological map of the Kinta District is being prepared. Work in this connection has shown that hitherto unsuspected deposits of tinstone may occur in the schistose rocks of this area, and this subject will be dealt with in detail when the map is completed. During 1909 the Rantau Panjang lignite deposit was prospected by the Mines Department, and a sample of the material examined gave the following percentage results: Moisture, 20·16; combustible volatile matter, 33·53; fixed carbon, 45·00; ash, 1·31 (some samples yielded much more ash). The calorific value was 5,432 calories.

The report by the Conservator of Forests gives information regarding the area, improvement, surveys and working of the State forests, notes on plantations and particulars of the yield of "Major" and "Minor" forest produce. The latter includes "wild" rubber from *Willughbeia urceola*, gutta-percha and damar resin.

In the Report of the Department of Agriculture it is pointed out that the output of rubber in 1909 was 6,083,943 lb., as compared with 3,192,710 lb. in 1908, an increase of almost 100 per cent. There was no serious amount of disease on rubber estates, but "root disease" is still troublesome and costly to treat. White ants still give trouble, but are no longer a serious pest. The Government Entomologist states that the worst insect pest affecting Para trees during the year was a cricket,

Brachytrypes achatinus. In the experimental plantations a good deal of work on rubber is in progress, including tapping experiments, trials of close planting, comparison of clean weeding with cover-plant methods, and cultivation trials of the following species of rubber trees: *Manihot dichotoma, M. piauhyensis, M. heptaphylla, Ficus elastica, Castilloa elastica,* and *Raphionacme utilis.* The area under coconuts increased by 5,118 acres, mostly in the State of Perak. Among other products receiving attention in the experimental plantations is camphor, and 20 acres of land have been planted with 7,000 trees in 10 plots, in each of which a different distance between each consecutive pair of trees has been allowed, so that this experiment will, it is hoped, furnish information as to the best planting distance. Experiments are also in progress with coffee (*Coffea robusta*), cocoa, oil-palm, animi resin (*Hymenæa Courbaril*) and various fibre plants. The following conclusions are drawn as the result of an extensive series of experiments with "cover plants." Cover plants as a substitute for weeding on old land are a failure, as the land generally becomes infested with "lalang." As an aid to weeding they tend to reduce the cost of weeding, but they also tend to retard the growth of trees planted amongst them. *Tephrosia purpurea* is the best cover plant for general purposes as an aid to weeding, but *Passiflora fœtida* does very well on low-lying or peaty ground, though not on dry slopes.

The report of the Director of the Institute of Medical Research gives a brief *résumé* of the important work on the causation of beri-beri, carried out during the last four years at the Institute, the results of which seem to indicate clearly that this disease is caused by the use of polished rice as a diet, the process of polishing removing certain constituents from the outer surface of the grain, which are essential to the maintenance of health in persons subsisting mainly on rice diet. Other subjects which have received attention are: (1) the revision of the scales of diets in prisons and asylums, (2) the prevention of ankylostomiasis and (3) anti-malarial measures.

AUSTRALIA.

Departments of Agriculture.

VICTORIA.—*Journal of the Department of Agriculture,* 1910, 8. Part 8.—The potato eelworm (a descriptive article continued from Part 2)—The wool industry (a general account of the present position of this industry in Australia). Part 9.—Handling grain in bulk (a description of modern methods of handling grain in Canada and elsewhere)—The value of pedigree in seed wheat (draws attention to the ways in which seed wheat may be rendered impure by accidental admixture of other varieties and to the desirability of maintaining pure strains)—"Scab" and "eelworm" in potatoes (treatment of seed with formalin proved efficacious as a preventive of scab, whilst the use of "scab"-free seed potatoes and the application of artificial manures to the crop are import-

ant factors in the production of a clean crop. In the case of eelworm green manuring and artificial manures appear to be of importance in the eradication of the pest and here also seed free from eelworms should be employed for sowing)—Testing lucerne seed (tests of the germinating power of 34 samples, mostly imported, showed that this varied from 3 to 97 per cent., whilst the quantity of weed seeds ranged from nil to 2· per cent. The failure in germinating power was mainly due to the presence of hard seed, which was particularly prevalent in seed o Australian origin). Part 10.—Influence of stubble burning on the fertility of soil—The chestnut (gives an account of chestnut cultivation in France and suggests that greater attention might be paid to this tree in Australia since it furnishes nuts, excellent timber especially for coopering purposes, and the waste wood can be utilised for the manufacture o chestnut extract to be used in tanning. In France the chestnut-extrac industry has grown so rapidly that the tree is being gradually extermin ated there, and in consequence the price of the wood has risen fron 11*s.* 2*d.* to 14*s.* 5*d.* per ton)—The wine industry in Southern Franc (continued from previous numbers. This section deals with the industr in the Department of Hérault).

NEW SOUTH WALES.—*Agricultural Gazette*, 1910, **21.** Part 8.—Shee and wool for farmers (deals with the classification of breeds)—Insect vorous birds of New South Wales (continued from Part 5)—Notes o maize smut—Wheat experiments, season 1909 (the results of thes trials by farmers in different parts of the State show that in yield c grain "Federation" takes the first place, and that there is little differenc in yield between "Florence," "Rymer," "Comeback," "Bunyip" an "Thew," all of which with the exception of the last, which yields weal straw and flour, can be recommended for grain-growing districts. Th use of superphosphates is profitable on almost all soils in the wheat growing areas, and on soils that have been long under cultivation th addition of a small quantity of sulphate of potash is advantageous)— Manchurian millets (trials with white and yellow "Hsiao-mi" millet from Manchuria at the Grafton Experimental Farm showed that the were far superior to Hungarian millet and would be very suitable fo catch-crops)—"Federation" wheat from farmers' and millers' points o view—Notes on a fungus found destroying potatoes—Australian dr farming. Part 9.—Farmers' experiments on potato varieties 1909-1910—Observations on "bunt" and fungicides—Experiment Farm (an account of the work in progress at the Wagga Experiment Farm)— Insectivorous birds of New South Wales (continued from the previou number)—Black maize (gives an analysis of a black maize grown in th State, which is said not to be attacked by weevils. It differs fron ordinary maize in being poorer in albuminoids and rather richer i starch)—"Blue couch," as a lawn grass—Japanese hemp (trials of thi plant, *Hibiscus cannabinus*, have not given good results)—"Chou Moellier" (describes this plant, which is being grown for fodder at th

Hawkesbury Agricultural College)—Scale-eating moths—Notes on wheat culture (deals particularly with the cultivation of this crop in a dry district with an 8-inch rainfall). Part 10.—Farmers' experiments. Summer crops, season 1909–1910 (the materials experimented with included maize for grain, and maize, sorghum, millet, and cowpeas for fodder).

QUEENSLAND.—*Agricultural Journal*, 1910, **25.** Part 3.—Banana manuring experiments at Buderim Mountain—Soil waste in the cane field (discusses the loss of constituents nutritive to plants by soil drainage and gives recommendations as to the kind of manure to be applied and the best methods and times of application)—The date palm for Western Queensland (this tree is recommended for the plains of Western Queensland, and in that connection particulars are given of climate and soils suited to the palm, with notes on the method of cultivation)—Kapok (it is pointed out that from 10,000 to 12,000 bales of kapok are imported into Australia every year, mainly from Java, and it is suggested that the tree, which thrives everywhere in tropical Queensland and in Papua, should be utilised there for the production of this floss. Particulars are given of the method of cultivating, ginning, baling, and shipping the fibre from Java). Part 4.—Dry farming (a *résumé* of recent information on this subject with reference to the "dry farming" Conference held at Sydney. Illustrations of the machinery employed are given)—Wheat culture in Queensland—Contributions to the flora of Queensland——The wild cochineal insect with reference to its injurious action on prickly pear (it is recorded that in certain parts of India *Opuntia* species—cacti of the prickly-pear type—have been completely eradicated by the introduction of the wild cochineal insect, and unsuccessful attempts were made in 1903 and 1904 to introduce it into Queensland. The introduction is to be attempted again with the co-operation of the Government Entomologist in Ceylon).

SOUTH AUSTRALIA.—*Government Resident's Report on the Northern Territories*, 1909.—This contains a report by the Curator of the Botanic Gardens at Palmerston, which details the progress made in the cultivation and extraction of Sisal hemp, and records a series of varietal and manurial experiments with rice. It is considered that cigar tobacco cultivation and the planting of coconut palms might with advantage be taken up by settlers. Particulars of the present position of the stock and mining industries are also given in special reports.

Journal of the Department of Agriculture, 1910, **14.** No. 1.—Hints to intending irrigationists (describes the erection of pumping plants, and gives a series of suggestions and precautions to be borne in mind by those intending to undertake irrigation—Agriculture in other lands (Part II. of a series of articles by the Principal of Roseworthy Agricultural College. In this section the production of wine, currants, and other crops in Greece is dealt with)—Potato experiments (gives the results of a series of tests with phosphatic, potash, and nitrogenous manures alone

and in combination, for different types of soil. The results of trials with various kinds of seed potatoes are also printed. The latter indicate that it is advantageous to change the source of seed from time to time). No. 2.—Wheat improvement (the second part of an article on this subject dealing with the selection of heads of varieties to be crossed and describing the method of cross pollination. Notes are also given on trials with "Federation" wheat at various places in South Australia from which it appears that the yields vary from 20 to 44 bushels per acre)—Deep *versus* shallow ploughing for wheat (discusses the question as to whether the extra yield obtained in deep cultivation compensates for the additional cost of labour).

Departments of Mines.

NEW SOUTH WALES.—*Department of Mines Report for* 1909.—The values of the outputs of zinc, tin, platinum, molybdenite, tungsten (as wolfram and scheelite), alunite, Portland cement, opal and diamonds increased, whilst those of coal, gold, silver, lead, copper, iron, antimony, bismuth, and oil shale diminished; the net decrease amounting to £973,913, the total value of the mineral output having sunk to £7,635,693. The decrease was mainly due to labour disputes. Details are given of the conditions affecting the production of the different minerals and the mining operations carried on. The report of the Government Geologist included (1) a report on the Yerranderie Silver Field, showing that the lodes are persistent in depth and contain silver-lead ore of high grade; (2) one on the supposed diamond-bearing volcanic pipe at Snodgrass near Delegate (which does not hold out much hope of success); (3) reports on the mines at and near Tottenham, the Parkes-Forbes Goldfield, the iron-stone deposits in the parish of Eurundury, Philip co., six miles north of Mudgee (which contain about 1 per cent. of phosphorus) and on the existing conditions of gold mining at Wyalong, where the outlook was considered favourable for further "bonanzas."

Records of the Geological Survey, 1909, Part 1. *The Geology of the Murrumbidgee District near Yass.*—This comprises portions of the counties of Murray, Harden, Buccleuch and Cowley, about 35° south and 149° east. The formations represented include Silurian, Devonian, with acid lava flows, Tertiary with basic lavas and Quaternary. Intrusive rocks (granite and porphyry) also occur. Limestone both of Devonian and Silurian age is found, as well as Quaternary travertine. Considerable attention is given to the evolution of the structure and configuration of the district. The maps are on scales of 1″ = 1 mile; 1″ = 990′, 1″ = 660′ (1 furlong) and 1″ = 330′.

QUEENSLAND.—*Government Mining Journal, August* 1910.—Opening of the Boyne Valley Railway (it runs from a junction with the North Coast Railway near Gladstone, south-eastward for more than 50 miles to Many Peaks in the Glassford Creek Mineral Field, where iron

ore containing 2 to 3 per cent. of copper and a little gold is found. The transport of this ore to Mount Morgan, where it will be employed as a basic flux, will constitute for some time at least the main traffic of the line)—The manufacture of coke from "non-coking" coal—Recent discovery of a Trias-Jura coal near Dalby, on the Southern and Western Railway, 140 miles from Brisbane (it is a low-grade bituminous coal with fairly high ash, suitable for gas-making and household purposes; it will probably be employed in working the railways to the westward)—Petroleum in Queensland (no payable occurrence has yet been met with)—Electrolytic preparation of chlorine and chlorination at Mount Morgan.

NEW ZEALAND.

Journal of the Department of Agriculture, 1910, **1**. No. 4.—Plant breeding (a description of some of the more important results achieved in plant breeding in recent years with suggestions for similar work in New Zealand on grass, cereals, green fodders, fruits, and certain root crops)—Experimental farm work (a record of recent experiments with potatoes, turnips, and mangolds, and of trials in the selection of good strains of wheat and oats and in the improvement of *Phormium tenax*, etc.).

WEST INDIES.

Imperial Department of Agriculture. Bulletin, 1910, No. 1.—The control of scale insects in the British West Indies by means of fungoid parasites (four species of fungi parasitic on scale insects occur in the Lesser Antilles. These may be artificially spread by "spore-spraying" or "tying-in" methods. The protection of lime trees by "Bengal beans" is probably due to the encouragement these afford to the growth of the parasitic fungi. In view of these facts it seems likely that this natural means of controlling scale insects will give good results in the West Indies, and in using sprays for the destruction of insect pests it may prove desirable to avoid those which destroy fungi. The article gives detailed descriptions of the fungi, discusses the climatic factors affecting their usefulness and details their present distribution among the Islands, etc.)—A new West Indian "cacao pod disease"—A preliminary note on a new species of *Colletotrichum* which has been named *C. Cradwickii*, the parasitism of which is being investigated—Nomenclature of scale insects—Notes on lime cultivation (a *résumé* of the results of recent experiments carried out in Montserrat. These show that clean cultivation and frequent tillage produce vigorous growth and early bearing, but these advantages are offset by severe attacks of scale insects)—The planting of fruit trees (in a review of the ninth Report of the Woburn Experimental Fruit Farm published in this *Bulletin* (1909, **7**, 239) attention was directed to the radical change in methods of planting fruit trees suggested there. A series of comparative experiments has been carried out in the Lesser Antilles with fruit cocoa, rubber and bay trees, in which planting by (*a*) the old method,

and (*b*) the new method was tried. The results are inconclusive as regards Antigua and St. Kitts, owing to abnormal climatic conditions, but in Dominica and Montserrat the results on the whole are in favour of the old method, though it remains to be seen whether the trees planted by this method show a permanent advantage over those planted by the new method)—Report on a visit to the Guanica Central Sugar Factory, Porto Rico—Manurial experiments with cotton in the Leeward Islands—The root development of cotton plants in different soils.

BAHAMAS.—*Bulletin of the Department of Agriculture*, 1910, 5. No. 2.—The cotton industry (a *résumé* of information giving the history of cotton cultivation in the West Indies, a descriptive account of varieties of the cotton plant, the factors determining the quality of this staple, its cultivation, harvesting, preparation, cost of production, etc., and concluding with an account of recent experiments at the Experiment Station in the Bahamas). No. 3.—Rubber cultivation in the Bahamas (deals especially with *Cryptostegia grandiflora*).

TRINIDAD AND TOBAGO.—*Mines Department. Administration Report of the Inspector of Mines for* 1909–10. *Council Paper No.* 85 *of* 1910. —A summary of the mining operations of the year, with a list of mines, borings and quarries and statistics of output, etc. The asphalt and manjak obtained are valued at £91,918. No figures relating to the output and value of oil are given. Limestone is practically the only other product of importance.

CANADA.

Departments of Agriculture.

Report of the Minister of Agriculture, 1909–10.—This gives a general account of the position of all branches of Canadian agricultural industry during the year, with data regarding the more important development and experimental work carried on. Attention is being given to the testing of seed for germinating power, and out of 2,527 samples collected officially through ordinary trade channels during the year only about 33 per cent. gave a highly satisfactory germination, 49 per cent. being of medium value, and 18 per cent. inferior. At the Central Experimental Farm a new wheat, "Marquis," which ripens from 7 to 10 days earlier than "Red Fife," is equal to the latter in quality and superior in productiveness, has attracted much attention, and supplies of it have been issued to 1,500 farmers. New experimental farms have been opened at Rosthern for Central Saskatchewan and at Charlottetown for Prince Edward Island.

Baking trials with artificially bleached flours showed that these produced paler breads than natural flours and were not inferior in baking quality. Special reports by the Chief of the Tobacco Division and by the official Delegate to the International Institute of Agriculture are printed as appendixes.

NOVA SCOTIA.—*Annual Report of the Secretary for Agriculture*, 1909.—This is divided into 3 parts. The first gives a summary of agricultural work in the province during the year with a number of special reports on the work, educational and experimental, done at the Agricultural College. Part II consists of a series of 24 articles dealing in an educational manner with the soils, soil cultivation and chief crops of Nova Scotia. Part III is devoted to the reports of local agricultural Societies.

Departments of Mines.

Mines Branch. Bulletin No. 2. Iron Ore Deposits of the Bristol Mine, Pontiac County, Quebec.—A summary of information regarding the ore deposits of the Bristol mine published in view of the proposed erection of an electric smelting plant near Chats Falls, on the Ottawa River. The mine is situated within five miles of the falls. It has not been worked since 1894 and is now full of water, and no plan of the workings or exact information as to their extent could be obtained. The ore-bodies were therefore located by magnetometric surveying, which showed that they were of promising extent. The tonnage of ore available could not be estimated. The ore is magnetite occurring in schists of Keewatin age. The phosphorus averages only 0·005 per cent., but the sulphur is high, owing to pyrite which occurs in small patches throughout the ore. Experiments on the magnetic concentration of the ore showed that the sulphur could be reduced by over 90 per cent. The *Bulletin* is accompanied by two illustrations of the mine and two maps on the scale of two hundred feet to the inch.

Geological Survey Branch. Memoir No. 6. 1910. *No.* 1082. *Geology of the Haliburton and Bancroft Areas, Province of Ontario.*

The area described in this report lies near the south-east margin of the extensive area occupied by Archæan rocks. Cambrian outliers occur in the south of the Bancroft sheet and there is a mantle of drift over most of the district, but the bulk of the rocks mapped belong to the Grenville series of highly metamorphosed sediments and the igneous intrusions of the Laurentian. Over three hundred pages are devoted to a description of these ancient rocks. In the Grenville series crystalline limestones predominate and are said to have a total thickness of 50,000 feet; some of them are dolomitic. The remainder of the series consists of gneisses of sedimentary origin, quartzites, arkoses and conglomerates. The Laurentian rocks include granites and granite gneisses, pegmatites, gabbros, diorites, amphibolites and a group of nepheline and other alkali syenites. Patches of acid volcanic rocks also occur.

Of the economic resources the most important is corundum, which occurs in the nepheline syenites. The others are gold, copper, lead, molybdenum, iron, ochre, pyrite, mispickel, mica, talc, graphite, garnet, apatite, marl, marble and sodalite. The report is illustrated by seventy plates, and by drawings in the text. It is accompanied by two geological

maps, the Haliburton sheet on the scale of four miles to an inch, and the Bancroft sheet on the scale of two miles to an inch.

BRITISH COLUMBIA.—*Annual Report of the Minister of Mines*, 1909.—The value of the mineral production of the Province in 1909 was $24,443,025, against $23,851,277 in 1908. The increase was most marked in the case of coal; gold, silver and copper showed decreases. Coal is now the most important product, followed by copper and gold; these three account for over 80 per cent. of the total; the remainder being supplied by lead, silver and other products. The report includes a good general account of the Rocky Mountain coalfields and is illustrated by numerous plates and diagrams.

COLONIAL AND INDIAN PUBLICATIONS.

In the following paragraphs a summary is given of the more important contents of the chief Colonial official periodical publications received recently at the Imperial Institute, in so far as these relate to agriculture or to economic products and are likely to be of general interest.

NYASALAND PROTECTORATE.

Colonial Reports—Annual, 1909–10. No. 655.—Details of the principal agricultural exports for 1909–10 have been given already (this *Bulletin*, 1910, **8**. 294). The total value of exports was £110,866, the chief items being coffee £15,574, tobacco £27,120, cotton £26,209, ground-nuts £4,750, rubber £4,261, maize £4,012, beeswax £2,854, and ivory £1,765, all of which show increases in quantity or value with the exception of coffee, beeswax and ivory.

Government Gazette, 1910, **17**. No. 13.—Contains the text of a bill entitled "An ordinance to deal with the cultivation of cotton," and which will empower the Governor in Council to make rules, (1) distinguishing between native and other cotton, (2) regulating the issue of cotton seed to natives, (3) regulating the planting, cultivation or harvesting of native-grown cotton, (4) regulating the sale of native-grown cotton, (5) dealing with cotton diseases, (6) regulating the importation of cotton seed, and (7) for the protection and control of the cotton industry.

UGANDA PROTECTORATE.

Official Gazette 1910, **3**. No. 58.—Contains a note on a tour made by the Governor through the Buganda and Busoga districts, in the course of which cocoa, coffee and rubber (Para) plantations at Kivuvu, the rubber factory in the Mabira Forest and various rubber estates in Kagwe were inspected. A report by the acting Superintendent of the Cotton

Department shows that great progress is being made in cotton cultivation in the Kumi and Bululu districts, the areas under the crop having been largely increased, and the crops being for the most part well grown. No. 59.—Contains rules made under the Cotton Ordinance of 1910, dealing with the issue, etc., of licences to persons, not natives of Uganda, for the purchase of cotton in the Protectorate. No. 61. —Contains a report by the Imperial Institute on Ceará rubber from a plantation at Entebbe.

BRITISH WEST AFRICA.

NORTHERN NIGERIA.—*Gazette*, 1910, 11. No. 8.—Contains a report by the Imperial Institute on *Moringa pterygosperma* seed (ben oil seed), and a note on "bori," a term applied to the rites and ceremonies of a sect of natives, who simulate the behaviour of the insane.

GOLD COAST COLONY.—*Colonial Reports, Annual*, No. 654, 1909.—The total exports were valued at £2,655,573 as compared with £2,525,171 in 1908. The principal increases were as follows: cocoa £214,526, rubber £95,550, palm kernels £34,604, kola nuts £9,488, and copra £3,961. The chief decreases were gold and gold dust £143,938, due to suspension of operations in several mines owing to development work and the necessity of increasing reserves of ore, timber £75,369, mainly due to low prices ruling for timber, and palm oil £8,557. The report contains a summary of work done for the Colony at the Imperial Institute during the year.

Government Gazette, 1910, No. 81.—Contains the quarterly report of the Agricultural Department for April to June, and describes especially educational work in agriculture, accomplished during tours by travelling instructors in the Eastern and Central Provinces and in Ashanti. No. 88.—Contains the fifth report (1909–10) by the Inspector of Agriculture for West Africa on Agricultural and Forest Products of the Gold Coast. It deals especially with pests affecting the rubber and cocoa trees, and with the preparation of rubber. No. 89.—Contains a report on the trade of the Northern Territories, the chief products of general interest being Shea butter, ground-nuts, maize and ivory.

SIERRA LEONE.—*Colonial Reports, Annual*, 1909, No. 648.—The total value of the exports of the produce and manufactures of the colony was £759,917 against £529,849 in 1908, mainly due to increases in quantity and value of the exports of palm kernels and palm oil. It is pointed out that a large proportion of the oil palm produce available in Sierra Leone cannot be utilised at present owing to lack of transport facilities. There was a slight increase in the production of ginger. The copal industry shows no development, but about 500,000 seedlings of this tree are now in the nurseries, and will be available for planting out in 1911. These will not bear for many years, but efforts are being made to make the native chiefs acquainted with the value of copal, so that existing copal trees may be utilised, and this action

should stimulate production in the near future. In spite of the absence of a properly organised Agricultural Department a considerable amount of experimental work in the planting of rubber, cocoa, copal, kola and ginger is being accomplished.

NOTICES OF RECENT LITERATURE.

NEW BOOKS.

A TRANSFORMED COLONY: SIERRA LEONE, AS IT WAS, AND AS IT IS, ITS PROGRESS, PEOPLES, NATIVE CUSTOMS, AND UNDEVELOPED WEALTH. By T. J. Aldridge, I.S.O., F.R.G.S. Pp. xvi + 362. (London: Seeley & Co., Ltd., 1910.)

This book is to be regarded as of special importance, since it seldom happens that an account of a West African country is written by one with the extended first-hand experience of the author. It is more than a supplement to his previous volume on "Sherbro and its Hinterland," being a critical, but simply written survey of modern Sierra Leone as contrasted with the colony and hinterland in the early seventies of last century, when the author's experiences of the country began.

The progress of Sierra Leone received its first impetus on the establishment of the Protectorate in 1896. No real advance was possible until the disturbing effect of dangerous warlike tribes in the hinterland had been removed. The natural complement of this policy was the building of a Government Railway into the heart of the territory so acquired, and a line 227 miles long, tapping the resources of a huge area with a population estimated at between one and two millions, has been completed. The whole of this country is now under complete official control.

The first few chapters of the book are devoted to a description of modern Freetown, its trade, population, food supply and municipal government. The revolution that has taken place in the trading methods of the colony is then dealt with. The old system under which the large European merchants were wholesale merchants only, leaving all retail business to native traders, has passed, and the firms have become their own middlemen, much to the detriment of the formerly prosperous traders. This latter extensive class has suffered from the popular parcel-post system of purchase, but their greatest menace is the ever-increasing commercial success of the itinerant Syrian traders, especially in the up-country districts. Dealing with broader issues, it is evident that the author is not satisfied that full advantage is at present taken of the resources of the country, nor with the attitude of European merchants with regard to their development. It is strongly urged that the trading firms should themselves enter the actual producing areas, and by scientific methods and use of machinery exploit the great resources of

the country, instead of relying solely upon produce brought in by the natives as is almost invariably the present system. The author recognises the vast improvement in conditions of health effected during his experience of Sierra Leone. The discoveries with regard to malaria, the establishment of hill residences within easy access of Freetown by the Mountain Railway, and the improved water supply have done much to discount the notorious reputation of the country with regard to health, though it is admitted that there are still special dangers. An excellent account of the railway journey from Freetown to Baiima is given in a series of chapters describing the country traversed and its resources. The journey was continued by road, jungle and forest to Mendikama and Pendemba, and thence to Sulima on the coast. The author has described much of interest with regard to native customs, and a special article, contributed by Major Anderson, deals with the remarkable steatite figures recently discovered. Examples of these figures are exhibited in the Sierra Leone Court of the West African Section of the Imperial Institute. The book concludes with two chapters upon the oil palm and kola tree respectively. An official map is appended.

LABRADOR: ITS DISCOVERY, EXPLORATION, AND DEVELOPMENT. By W. G. Gosling. Pp. xii. + 574. (London: Alston Rivers, Ltd., 1910.)

In the early part of the sixteenth century, Newfoundland, Labrador, and indeed the whole of the north-east coast of America were known under the general designation of Newlands or Terre Neuve. The actual date of the discovery of Labrador by Europeans is not easy to determine. Mr. Gosling reviews the evidence for and against the truth of alleged visits by Norsemen about A.D. 1000; on the whole it appears probable that the Helluland, or "land of flat stones," reached by them was Labrador, and that Markland was Newfoundland.

The authenticity of the report of John Cabot's visit in 1497 is also difficult to establish. The region has, however, been claimed by England since the reign of Elizabeth by virtue of its discovery by Cabot; and in Ribero's map, prepared in 1529, the claim is recognised with the interesting comment "there is nothing here of much value."

With so much of the early history of the country veiled in obscurity, it is scarcely surprising that the origin of the name is a subject of speculation. "Le bras d'or" is dismissed as an obvious misnomer. The balance of evidence favours the view that it was called "Tierra del Labrador," in commemoration of the fact that an Azores labourer (Portuguese *lavrador* or *labrador*), one of Cabot's crew, first sighted the land.

The author traces the gradual growth of knowledge of the region gained by Portuguese and Spanish visitors, and by the constant procession of vessels from England and Brittany early engaged in exploiting the valuable fisheries. The quest of the N.W. passage also extended our knowledge of the coast.

An interesting document, reprinted *in extenso*, is a lengthy memoir on Labrador by an unknown author, probably a French priest, describing the condition of the country in 1715-6, forecasting a great and prosperous future and making practical suggestions whereby this vision might be realised. Coming to more recent times, Mr. Gosling gives an appreciatory account of the work accomplished by the Moravian Brethren during their 137 years of labour amongst, and on behalf of, the Eskimos. Matters of controversy, such as the Americans in Labrador, the fisheries and the boundary dispute with Canada, are well dealt with, and the concluding chapter is devoted to Dr. Wilfred Grenfell, C.M.G., so well known for his philanthropic work amongst the fishermen and others.

The main asset of Labrador, the fishing industry, is fully treated, the author expressing the opinion that it must remain predominant although recently a considerable amount of timber for wood pulp has been exported.

The book is excellently illustrated and has several maps and charts, some of great antiquity and interest. It should prove of the first importance to all desirous of acquiring information about this little-known portion of the British Empire.

Sir Joseph Banks: the Father of Australia. By J. H. Maiden. Pp. xxiv. + 244. (Sydney: W. A. Gullick, Government Printer. London: Kegan, Paul, Trench, Trubner & Co., Ltd., 1909.)

This book appears under special circumstances and with an object additional to that of disseminating information about the great scientist and traveller, the centenary of whose death is only ten years distant. A "Banks Memorial Fund" has been initiated for the purpose of providing Australia with some worthy permanent memorial of the man, with reference to whom Linnaeus wrote in 1771, "the newly found country ought to be named Banksia from its discoverer, as America was from Americus." Of this fund Mr. J. H. Maiden, Government Botanist of New South Wales and Director of the Botanic Gardens, Sydney, is treasurer, and he calls this volume his main contribution to the fund, which he hopes will profit by its sale.

Sir Joseph Banks, a man of considerable fortune, used his wealth and influence with marked consistency, throughout his life, to advance scientific knowledge. He travelled largely himself, notably to Newfoundland in 1766, on Cook's first voyage, 1768–1771, and to Iceland in 1772.

Banks practically equipped Cook's ship, the *Endeavour*, for work in natural history, and took with him, at his own expense, the botanist Solander, three draughtsmen, an assistant and four servants. The scientific observations of Banks himself, chiefly on natural history, were not inconsiderable, and are recorded in his Journal, an edition of which, edited by Sir Joseph Hooker, appeared as recently as 1896. The main achievements of the voyage are well known; New Zealand was cir-

cumnavigated and subsequently Australia discovered, Banks and Cook landing at Botany Bay on April 28, 1770.

On his return from Iceland, Banks settled in London and amassed at his house in Soho Square the famous Banksian library and herbarium, the latter becoming subsequently the nucleus of the general herbarium of the British Museum (Natural History Section). Especially noteworthy are the achievements of the men whom Banks gathered about him and to whom he was, in the best sense of the word, a patron. The famous botanists Solander, Dryander and Robert Brown were successively custodians of his library, and "largely carried on the botanical work of the Kingdom by means of the Banksian herbarium, which was really a public institution although maintained by the purse of Banks." He employed directly, or assisted in various ways, many botanical collectors who, as he himself did on his travels, contributed greatly to our knowledge of the flora of the world. Lastly must be mentioned the Banksian artists including William Westall, Ferdinand and Francis Bauer, the latter of whom, largely through the liberality of Banks, was attached to Kew Gardens for fifty years as resident draughtsman.

Banks in many other ways promoted the interests of science. In 1778 he became President of the Royal Society, a position which he retained until 1820, the year of his death, *i. e.* for over forty years. He was scientific adviser to King George III, and both in this country and on the Continent was regarded as the representative of British Science. His own bent towards natural history, especially botany, led him to take great interest in the Royal Gardens, Kew, of which he became Honorary Director in 1772.

The famous voyage of the *Bounty* was due to Banks, the chief object being to introduce the bread-fruit from Tahiti into the West Indies. This was frustrated by the mutiny, but a subsequent voyage, also under Bligh, was more successful. Banks is also said to have been the first person to introduce specimens of rubber into England, which he did in 1766 on returning from Newfoundland *via* Lisbon.

Sir Joseph Banks deserves a high place in the records of science, and it is especially fitting that an effort is being made to give adequate recognition to his achievements in Australia, the land which owes its discovery largely to him and the early exploration and colonisation of which he did so much to promote.

BRAZIL IN 1910. By J. C. Oakenfull. Pp. 280. (Devonport: The Author, 1910.)

An interesting account of the United States of the Southern Hemisphere. The author is enthusiastic about its magnificent climate, and, now that the spectre of yellow fever has been laid, his enthusiasm is fully justified. He describes in detail its well-nigh inexhaustible agricultural and mineral resources and the advantages it holds out to emigrants who know how to adapt themselves to conditions differing widely from those to which they are accustomed. Tables are appended

giving the rates of wages, the cost of commodities, the customs duties (which are unusually high), and statistics of the different industries. The book concludes with a useful Bibliography of the country.

VON DER HEYDT'S KOLONIAL-HANDBUCH. JAHRBUCH DER DEUTSCHEN KOLONIAL- UND UEBERSEE-UNTERNEHMUNGEN. Fourth annual issue. Edited by Franz Mensch and Julius Hellmann. Pp. xxxviii. + 335. (Berlin, Leipzig and Hamburg: Verlag für Börsen und Finanz-Literatur A.-G., 1909.)

This useful work has already been noticed in this *Bulletin* (1909, 7. 138 and this vol. 102). The new edition records the progress of the German Colonies during the past year. The various undertakings which have been recently formed, including numerous South West African diamond companies and certain planting syndicates, have been inserted, and the whole work has been brought up to date.

WOBURN EXPERIMENTAL FRUIT FARM. Tenth Report by the Duke of Bedford, K.G., F.R.S., and Spencer U. Pickering, M.A., F.R.S. Pp. 50. (The Amalgamated Press Ltd., London, 1909.)

In this report the methods of freeing the trees of the orchard from insect enemies are dealt with. No single method has been discovered that will destroy all pests, the habits and weak points of defence of each species of insect have to be studied and the proper remedy devised, together with the right method and time of application. Treatment is prescribed to destroy the woolly aphis that infests apple stocks, the mealy plum aphis, the psylla or apple sucker and the caterpillars of the tent moth, the winter moth and gooseberry and currant sawfly.

In the case of the woolly aphis, fumigation with hydrocyanic acid gas, a troublesome operation and one attended with some danger to the operator, was found unsatisfactory; it often fails to destroy the eggs of the insect and its effects are rendered variable by different states of moistness of the trees and soil. The trees too are liable to be injured if the temperature is above 60° F. and if they are subjected to direct sunshine in a greenhouse during the fumigation. This insect has to be destroyed not only on the parts of the tree above ground, but also on the roots, where it is found both in summer and winter. Immersion of the whole trees for five minutes in various kinds of paraffin oil was tried; they were allowed to drain and were then planted. Solar Distillate and White Rose oils were found to cause too much injury to the trees, but Petrol (Pratt's Motor Spirit), a very light and volatile paraffin oil, killed the aphis without materially injuring the trees, these being in a dormant state. An even more satisfactory method was immersion of the trees in hot water at 115° F. for ten minutes, the temperature being maintained at that level.

The best treatment to destroy psylla was found to be spraying with nicotine solution between the time of the swelling of the fruit buds and the fall of the blossoms; the solution should contain not less than 0·075

per cent. of nicotine. Observations were made, however, which seemed to show that psylla is not really accountable for all the damage that is usually attributed to it.

As an agent for destroying caterpillars, nicotine solution proved inferior to paraffin emulsion, which acts both by poisoning the caterpillar's food and by corroding its body. If the emulsion is properly made and thoroughly emulsified, no scorching of the tree need be feared.

The report also describes experiments on the action of paraffin on trees in leaf, on tree roots and on soil. It was found that injury was done by spraying the trees when in leaf; the heavier oils, such as Solar Distillate, acted slowly, but eventually killed the leaves and branches; the lightest oils, such as Petrol, acted immediately, scorching the leaves but not killing the branches; the intermediate oils, such as the best lighting oils, caused very little damage to the foliage. Such spraying may be advisable for application to trees of little value when the aphis on them is a source of danger to other more important trees in their vicinity. The roots of trees when in the dormant condition were found to be less susceptible to injury than the branches; and as regards the soil, the oils even appeared to have a beneficial effect by increasing the supply of available plant food.

The report is full of practical information of great value to the fruit grower.

A RESEARCH ON THE PINES OF AUSTRALIA. By R. T. Baker and H. G. Smith. Pp. xiv. + 458. Technical Education Series, No. 16. Department of Public Instruction, New South Wales. (Sydney: W. A. Gullick, Government Printer, 1910.)

This handsomely illustrated volume is a companion to the *Research on the Eucalypts of Australia* of the same authors, and, like it, presents the joint work of a botanist and chemist on a group of plants of great economic importance. It should be noted at the outset that whilst Australian "pines" are conifers, they are not members of the genus Pinus, to which the pines of the Northern hemisphere belong. The pines of Australia include species of various genera, *e.g.* Callitris, Araucaria, Agathis, Dacrydium, Phyllocladus and Podocarpus; of these the genus Callitris is the most important.

The research covers an extremely wide field, as indicated by the following outline of the general mode of treatment of each plant dealt with:—botanical history; systematic description; leaves and fruit—economics, anatomy, chemistry of oils; timber—economics, anatomy, chemistry of products, forestry; bark—economics, anatomy, chemistry of products; illustrations.

One point of great interest which emerges from this piece of work, as from the authors' previous research on the Eucalypts, is that the chemical constituents of these plants, as present for example in their essential oils, are remarkably constant for each well-defined species, even over a

wide geographical range. This is a matter of considerable practical importance; it is also of high theoretical interest, as the authors rank these chemical characteristics with the more obvious external characteristics, and thus employ more complete data on which to found their views on the systematic relationships of the species.

It would be impossible in the space of a short review to attempt to summarise the mass of facts brought together in the volume. All interested in the group of plants known collectively as the pines of Australia will find it an invaluable book of reference, whether they be concerned with pure botanical questions or with the properties, uses and mode of collection of the various products these "pines" yield.

Special recognition should be made of the manner in which the book is illustrated, the coloured plates representing microscopical preparations being, in many instances, very good, whilst the black and white illustrations of foliage, fruits, etc., are exceedingly useful. If anything, perhaps, the "get up" is on too lavish a scale, the large size, the spacious arrangement and the special paper causing the book to be of very considerable weight. This, however, is scarcely to be considered a fault, and many a scientific department would be glad of the opportunity to publish its work in as worthy a manner.

SOUTH AFRICAN POISONOUS PLANTS. By L. H. Walsh. Pp. 56. (Cape Town: T. Maskew Miller, 1909.)

The principal plants of South Africa known to be harmful or actually poisonous to cattle are described, usually with illustrations reproduced from photographs. The descriptions are given in non-technical language in the hope that they may serve for the recognition of the plants by farmers. The characteristic symptoms produced by the ingestion of the plants are given, and the treatment to be followed in cases of poisoning is outlined. The nature of the poisonous constituent or constituents present in most cases is unknown, and the author rightly points out that the study of these plants offers a wide field for investigation by the chemist and the botanist. Unfortunately the isolation of the poisonous constituents from such material is usually an extremely difficult and tedious task, so that additions to our knowledge of the nature of plants poisonous to cattle are made but slowly. A number of the plants mentioned by the author are now under investigation at the Imperial Institute, notably, *Senecio latifolius*, "Slangkop" and *Homeria* spp. Of these the first is a near relative of the common ragwort, *Senecio jacobaea*, which in some parts of Canada causes the "Pictou cattle disease," whilst the third has allies in certain parts of Australia, which are also notoriously poisonous to cattle. Allusion is made to the occasional toxicity of green sorghum, which investigations at the Imperial Institute have shown to be due to the production of prussic acid (compare this *Bulletin*, p. 384). Certain of the plants mentioned are cosmopolitan in distribution, and have been completely investigated, *e.g.* the "thorn apple" (*Datura Stramonium*).

This publication, like that on "Plants poisonous to stock," issued by Mr. Maiden in Australia, not only serves the immediate purpose of affording practical information to farmers and stock-keepers, but calls attention to the need for the thorough investigation of such plants. The fact that the botanical names of the plants are given wherever possible and that the symptoms produced are carefully described will be of great service to investigators undertaking the detailed examination of the plants.

IRON AND STEEL ANALYSIS. By A. Campion, F.I.C., F.C.S. Pp. 80. (Vol. I. Ordinary Constituents.) (Glasgow: Fraser, Asher & Co., 1910.)

This little book, as is stated in the preface, is primarily intended for students attending evening classes, who are desirous of obtaining an insight, in a limited time, into methods for the analysis of iron and steel. For this purpose the book is well suited. In most cases only one method is described for the determination of each constituent, and the most elementary manipulative precautions are given in full. The estimations described include those of silicon, graphite, sulphur, phosphorus, manganese, carbon and arsenic. Methods for the proximate analysis of coal and coke are described briefly, and the book includes notes on reagents and the preparation of solutions used in iron and steel analysis.

GEOLOGICAL MAPS OF EGYPT. (1) Scale 1 : 1,000,000, six sheets; (2) Scale 1 : 2,000,000. (Survey Dept., Egypt, 1910.)

Two geological maps of Egypt have been recently issued by the Geological Survey of that country. The first consists of six sheets on a scale of about 16 miles to the inch; the second on half this scale. They are clearly printed with well-marked colours.

ANLEITUNG FÜR DIE BAUMWOLLKULTUR IN DEN DEUTSCHEN KOLONIEN. By A. Zimmermann. 2nd Edition. Pp. vii. + 159, with 25 Illustrations. (Berlin: Kolonial-Wirtschaftliches Komitee, 1910.)

During the last few years, cotton growing has made great progress in the German Colonies and a need has arisen for a suitable handbook for planters. The present work has therefore been written, which, it is hoped, will also be found useful to planters in other countries. The most important varieties of the cotton plant are described, and information is given with reference to the choice of the variety to be grown, the preparation of the land, manuring, irrigation, sowing, cultivation and harvesting. The last chapter is devoted to the pests and diseases of the cotton plant. A bibliography is appended.

The work is well and carefully written, and should be very serviceable for the purpose for which it is intended.

AUSZUG AUS DER ANLEITUNG FÜR DIE BAUMWOLLKULTUR IN DEN DEUTSCHEN KOLONIEN. DEUTSCH-OSTAFRIKA. By A. Zimmermann.

2nd Edition. Pp. 30, with 12 illustrations. (Berlin: Kolonial-Wirtschaftliches Komitee, 1910.)

This pamphlet is an abstract of the work referred to above, which has been prepared with special regard to the conditions existing in German East Africa, and is intended for distribution to planters. A translation in the Swahili language has been made, and will be distributed among the natives.

LE CELLULOÏD.—Par Masselon, Roberts et Cillard. Pp. iv. + 528, with numerous illustrations, plans and diagrams. (Paris: A. D. Cillard, 1910.)

Since the discovery of celluloid in 1869 great progress has been made in its manufacture and utilisation, but hitherto no complete and practical work on the subject has appeared. The present volume has therefore been written in order to supply this deficiency.

In the first part of the book the various processes of manufacture are described, special attention being paid to those which are in actual use. Practical details are given together with descriptions of the principal types of machines employed. Methods of analysis and mechanical tests are described, and attention is directed to the conditions under which the material is liable to inflame or explode.

The second part deals with the utilisation of celluloid, and gives an account of the manufacture of combs, handles of umbrellas and walking-sticks, boxes, toys, imitation linen, artificial teeth, phonograph cylinders, buttons, and many other articles. Special chapters are devoted to the employment of solutions of the material as lacquers and varnishes, to its uses in photographic work, and to the methods of colouring and decorating it.

In the third part of the work reference is made to the non-inflammable celluloids and also to celluloid substitutes. One chapter deals entirely with the replacement of the camphor of celluloid by other substances, including acetanilide, gelatine and naphthalene, and another describes the manufacture of such products as viscose, viscoid, and substitutes containing casein as a basis, such as cornalith and galalith. The last chapter gives an account of the acetates of cellulose and their uses.

The work constitutes a full and practical treatise, and will doubtless be of great value to all who may desire information on celluloid and its substitutes.

FLAX, HEMP AND JUTE SPINNERS' CATECHISM.—By H. R. Carter. Pp. iii. + 268, with 24 illustrations. (London: John Bale, Sons and Danielsson, Ltd., 1910.)

This work deals with the cultivation, extraction, preparation and spinning of flax, hemp and jute. It is written in the form of question and answer, and is based on the examination papers of the City and Guilds of London Institute, to which the author is an examiner. Although the book is primarily intended for students preparing for examination, it is hoped that it will also be of value to workers in the mills who have but little time and opportunity for study.

ESTADISTICA MINERA DE CHILE EN 1906 i 1907.—Vol. III. Pp. xi. + 518. (Santiago de Chile, 1909.)

The first part contains a general description of the republic and full statistics, from the earliest times, of the mineral output, prices, freights and the rate of exchange. The second part treats in detail of the occurrences of gold, silver, copper and other metals in the country, and the metallurgical processes employed to extract them. The third part refers to coal and petroleum, the fourth to nitrates, iodine, borates and salt, and the fifth to sulphur and guano. The sixth part is of a miscellaneous character, and includes a useful account of the mineral wealth of the territory of Magallanes and a short sketch of the geology of Chile.

PUBLICATIONS OF THE INTERNATIONAL ASSOCIATION OF TROPICAL AGRICULTURE AND COLONIAL DEVELOPMENT.—The following special reports on inquiries initiated by the Association, which were presented to the International Congress of Tropical Agriculture and Colonial Development held recently at Brussels, have now been published.

Cotton. "Report on the present position of Cotton Cultivation." By Prof. W. R. Dunstan, F.R.S. Price 1*s.* 0*d.* Post free 1*s.* 1½*d.* (*see this Bulletin*, p. 402).

Acclimatisation of European Cattle in Tropical Countries.

The following reports are available :—

Algeria.* By M. Monod. } Price 1*s.* 0*d.*, post free 1*s.* 0½*d.* each.
Tonkin.* By M. Douarche. }

Costa-Rica.† By Senor F. Peralta. Price 6*d.*, post free 6½*d.*

Rôle of Botanic Gardens in Tropical Agricultural Research.

Report by M. Capus.* Price 1*s.* 0*d.*, post free 1*s.* 0½*d.*

Report by Profs. Engler and Volkens.†† Price 1*s.* 0*d.*, post free 1*s.* 0½*d.*

Alcoholism in the Colonies and Tropical Countries.

Report by Dr. Kermorgant.* Price 1*s.* 0*d.*, post free 1*s.* 0½*d.*

Agricultural Labour Conditions in the Colonies and Tropical Countries.

PART I. Report for Jamaica (by Mr. Miles), Barbados (by Mr. Bovell), Southern Rhodesia (by Mr. Marshall Hole), Swaziland (by Mr. Coryndon), Gambia (by Dr. Hopkinson), Sierra Leone (by Mr. Haddon Smith), Nyasaland (by Mr. J. C. Casson), Leeward Islands (by Mr. Tempany), Bahamas (by Mr. Munro Cunningham), German East Africa and the Cameroons (by the German Colonial Economic Committee††). Together price 2*s.* 0*d.*, post free 2*s.* 1½*d.*

Publications marked* are in French, that marked† is in Spanish, and those marked†† are in German; the remainder are in English.

Copies of all these publications may be obtained on remitting the prices mentioned to the "Officer-in-Charge, Central Stand, Exhibition Galleries, Imperial Institute, London, S.W."

VOL. VIII, 1910

INDEX

Botanical names, Zoological names and Titles of Books reviewed, are printed in italics.